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October 28,2002

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Docket Management System
U.S. Department of Transportation
Room Plaza 401
400 Seventh Street, SW
Washington, DC 20590-0001

Re: Federal Aviation Administration Supplemental Notice of Proposed Rulemaking on Licensing and Safety Requirements for Launch (July 30,2002); Docket No. FAA 2000-7953; Notice No. 02-12

To Whom It May Concern:

On behalf of Lockheed Martin Corporation, The Boeing Company, Orbital Sciences Corporation, Sea Launch Company, L.L.C., and International Launch Services, Inc., enclosed please find two (2) originals of the consolidated industry response to the Supplemental Notice of Proposed Rulemaking on Licensing and Safety Requirements for Launch issued by the Federal Aviation Administration's Office of the Associate Administrator for Commercial Space Transportation on July 30,2002. Incorporated herein by reference is the consolidated industry response dated April 23,2001, that was submitted to the FAA's Notice of Proposed Rulemaking in this proceeding.

Sincerely,

Franceska O. Schroeder

Franceska O. Schroeder

FOS/lhd
Enclosures

Consolidated Industry Response

FAA SNPRM
Licensing and Safety Requirements for Launch
October 28, 2002
Docket Number FAA 2000-7953
Notice No. 02-12

Lockheed Martin Corporation

The Boeing Company

Orbital Sciences Corporation

Sea Launch Company, L.L.C.

International Launch Services, Inc.

Contents

Before the
FEDERAL AVIATION ADMINISTRATION
Washington, D.C. 20591

In the matter of	)	
	)	Docket No. FAA 2000-7953
Licensing and Safety	)	Notice No. 02-12
Requirements for Launch	)	

CONSOLIDATED INDUSTRY RESPONSE: COMMENTS OF LOCKHEED MARTIN CORPORATION, THE BOEING COMPANY, ORBITAL SCIENCES CORPORATION, SEA LAUNCH COMPANY, L.L.C. AND INTERNATIONAL LAUNCH SERVICES, INC.

I. INTRODUCTION

consolidated industry response dated April 23,2001, that we submitted to the FAA's Notice of Proposed Rulemaking ("NPRM")[2] in this proceeding. As you know, we five companies represent nearly the entire U.S. launch services industry. This consolidated response details the industry viewpoint as well as provides detailed supporting analysis in the form of a line-by-line review of the SNPRM with comments.

Issues Identified With NPRM...

1. Lack of Transparency
2. Unpredictable Requirements
3. Inconsistent with Current Practice
4. Inflexible
5. Unrealistic Assessment of Costs to Industry
6. Unnecessary Regulation and Oversight
7. Does Not Reflect Industry's Experience, Expertise, and Impeccable Safety Record

No Closer to Resolution with SNPRM

LMC, Boeing, Orbital and Sea Launch each also are submitting a cost impact analysis that documents the costs of compliance with the proposed regulations presented by the FAA/AST collectively in the NPRM and SNPRM as well as the impact of these costs on each of

[1] Docket No. FAA 2000-7953; Notice No. 02-12; 67 Fed. Reg. 49456 (July 30,2002).
[2] Docket No. FAA 2000-7953; Notice No. 00-10; 65 Fed. Reg. 63922 (Oct. 25,2000).

our individual businesses. Confidential treatment is requested for each of those cost impact analyses due to the business proprietary nature and competitive sensitivity of the information contained in those company-specific submissions.[3]

We appreciate the FAA/AST's decision to issue an SNPRM in this proceeding and hold a public meeting at which we each had an opportunity to present our preliminary views on the ***SNPRM*** and pose certain questions to the FAA/AST on this rulemaking.[4] We recognize the FAA/AST's efforts to address some of the issues we raised. However, we believe that many of the issues and concerns we articulated with respect to the NPRM remain inadequately addressed. In fact, the **SNPRM** raises new issues and concems, which we address in this submission.

Accordingly, we again ask the FAA/AST to address and resolve the issues we first identified in our comments on the NPRM, as we and the FAA/AST continue to work together to ensure that the public remains safe and the industry remains economically viable. Briefly, those issues are: (1) the need for transparency in terms of how the safety requirements will be applied and by whom; **(2)** the need for consistency in the application of those requirements; (3) the need for predictability with respect to application of the requirements; **(4)** the need for maintaining operational and technical flexibility in conducting launch operations; (5) the need for realistic cost assessments; ***(6)*** the need to avoid unnecessary regulations and regulatory oversight; and (7) the need to assure that industry's expertise, experience and impeccable track record for safety are given due consideration.

Rulemaking Is Ineffective Mechanism for Developing Single Safety Process

- **Rulemaking Process: Rigid deadlines and constrained, one-way communications** are resulting in technical inaccuracies and misunderstandings
- **Better Approach: Realistic, requirements driven timelines and iterative dialogue among all** parties will ensure effective safety process and shared understanding

Solution: Stop current rulemaking process, focus on interactive problem-solving

While the SNPRM addresses a few of the concerns we discussed in our NPRM response, most of our issues with respect to this rulemaking remain unresolved. Unfortunately, after painstaking review of the SNPRM, we do not believe that we are much closer to solving the problems we identified in the NPRM. We continue to find that the proposed regulations are not required for the FAA/AST to fulfill its mandate under the Commercial Space Launch Act ("CSLA")[5] to protect public health and safety, would result in duplicative and potentially conflicting requirements, and would have serious, negative financial and operational impacts.

[3] 5 U.S.C. § 552(b)(4).

[4] Notice of the public meeting, which was held on September 6, 2002 at FAA headquarters in Washington, D.C., was set forth in the SNPRM, 67 Fed. Reg. 49456-57 (July 30, 2002).

[5] 49 U.S.C. §§ 70101-21.

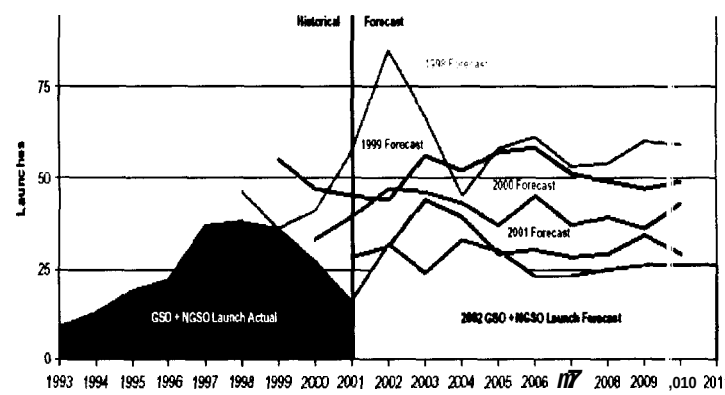
We submit that a traditional, formal rulemaking proceeding, which is constrained by relatively narrow channels of communication and rigid deadlines, is not the appropriate process for information exchange and deliberation on issues relevant to development, establishment, and implementation of highly technical and complex launch safety requirements. These objectives more effectively and constructively may be achieved through a more flexible, iterative process involving the FMAST, other interested federal agencies (*e.g.*, the Air Force), the **U.S.** launch industry and the interested public. The results of such a process, which would be documented, could be incorporated by reference in FMAST-issued launch licenses, as is the case with Eastern and Western Range 127-1, as tailored ("EWR 127-1"). The results of, or proposals resulting from, this dialogue could also then be made the subject of notice and comment rulemaking. Because this would be a collaborative process, we believe that it would be an effective means for achieving safety requirements and procedures. It would meet the FMAST's commitment to safety, without having the unintended result of imposing a wholly unnecessary burden on industry.

As was our consolidated submission to the NPRM, this response is based upon both our independent and collective assessments of the SNPRM. This response sets forth our concerns in a manner that, hopefully, will prove constructive and helpful to the FAA/AST in its review of the proposed rule and consideration of next steps.

II. CONTEXT

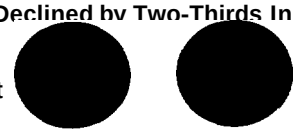
Each of us, either on our own or through our heritage companies, has a long history of providing launch services from federal ranges. Some of us also are users of non-federal ranges. Together, we serve the full spectrum of commercial, military and civil customers. Our experience and operational interaction with the ranges has significantly contributed to the safety of **U.S.** launch programs overall. We are very proud of our history as launch services providers and of the fact that the FMAST and industry have worked together very successfully on issues that were key to achieving the transition to private sector responsibility for **U.S.** commercial launches.[6] A cooperative, informed

Commercial Launch Market Is Contracting; FAA Launch Forecasts Have Dropped Dramatically



Source FAA/AST *2002 Commercial Space Transportation Forecasts* May 2002 p 5

US Market Share of Global Commercial Launch Revenue Has Declined by Two-Thirds In Five Years



39% US Market Share in 1996

11% US Market Share in 2001

Source FAA/AST *Commercial launch industry revenues FAA/AST 2001 Yearin Renew Table 8*

[6] For brevity, we will not repeat in this document a discussion of our history in the industry or with the federal and non-federal ranges, as it is well known to FAA/AST. For additional information on this topic, we refer the FAA/AST to our consolidated submission to the NPRM.

interaction between government and industry remains critically important today in order for the U.S. to maintain a robust commercial launch capability and assured access to space.

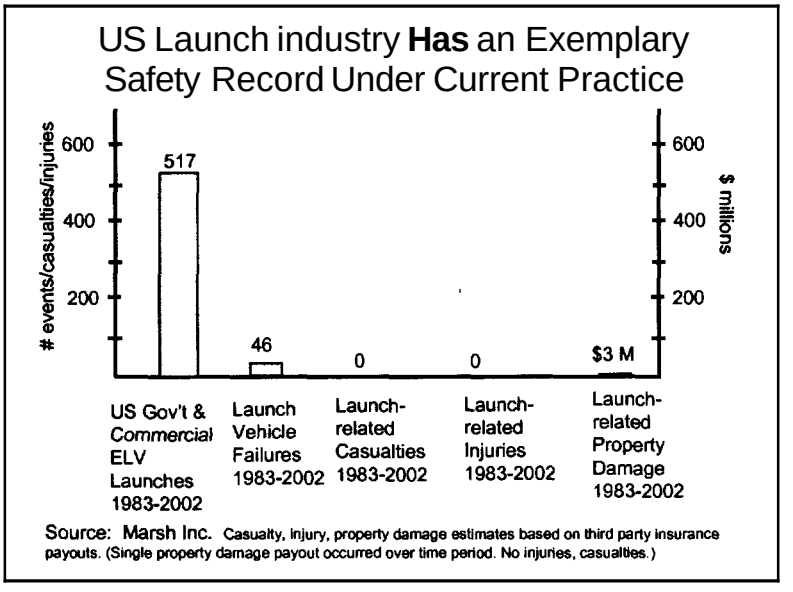
One issue that has intensified since our submission in response to the NPRM is the state of the commercial launch services market. The number of satellites to be launched has declined dramatically and the large pool of previously projected satellite systems requiring launch services has evaporated. Now more than ever, the commercial viability of the various members of the **U.S.** launch industry depends upon our ability to compete aggressively with other launch services providers and operators, such as Arianespace. The proposed requirements do not add a measurable benefit to public safety, but do impose significant burdens, including cost and operational burdens. They also would impair our ability to respond to short lead time commercial opportunities, which are schedule driven by both programmatic needs and the customer. The U.S. launch industry cannot bear additional burdens that would put its members at an even more disadvantageousposition relative to our competitors.

Another important issue is that the proposed rule would increase the cost of assuring access to space for the Department of Defense ("DoD") and the National Aeronautics and Space Administration ("NASA"). Costs imposed by this rule related to changes in hardware or procedures could result in added cost to DoD and NASA launches, as well as to commercial launches, because we cannot operate with two sets of hardware and procedures. In other words, cost increases in commercial program activities would affect overall program costs that would be passed on to all customers, commercial and government. If the costs of the proposed rule increase to the point that threatens viability of the U.S. commercial launch industry, the **U.S.** Government could be the party that bears the full burden of the cost of access to space. Given our nation's dependence on space for national and economic security, any action such as this rule that adversely affects our ability to assure access to space is not prudent and must be avoided.

> ***"...our number one priority is assured access to space."***
>
> ***Major General Franklin Blaisdell, Director of Space Operations and Integration, HQ USAF, at USDOT/FAA Supplemental Notice of Proposed Rulemaking (SNPRM) Public Meeting, September 6, 2002***

111. OVERALL VIEWS ON THE RULEMAKING PROCEEDING

Through this rulemaking proceeding, the FANAST proposes to codify all safety requirements that a U.S. launch operator must satisfy as a prerequisite for conducting commercial launch operations from any **U.S.** launch range. The FANAST asserts that it can accomplish this task: (a) without levying any new requirements; (b) without changing the fundamental way launch operators achieve compliance; and (c) without adding any significant cost to industry. We respectfully disagree. Indeed, our analysis yields quite a different result. We find that this rulemaking will: (a) impose new requirements on launch operators; (b) add complexity and duplication to the ways in which launch operators demonstrate compliance; and (c) be very costly to the space launch industry. Because the proposed rule will be extremely costly and disruptive to all affected parties, it will undermine the economic viability and competitiveness of an industry that is critical to **U.S.** economic and national security interests.



Like the F M A S T, our primary focus is on safety. Throughout the history of the launch industry, ensuring the safety of participants and the public has always been of paramount importance. Efforts in this regard have been resoundingly successful. Indeed, the U.S. can be proud of its impeccable safety record over more than five decades. From each of our perspectives, it would be impossible to overstate the importance we place on safety. Not only do we demand outstanding safety standards and practices of ourselves, but our customers and our shareholders also demand them of us. None of us would tolerate anything less.

We recognize the important role assigned to the F M A S T under the CSLA to protect the public health and safety and the safety of property. The F M A S T has fulfilled this mandate successfully over the course of almost 15 years of launches at federal ranges by incorporating into launch licenses the safety requirements imposed by the Air Force through EWR 127-1 and its predecessor documents. This approach has proven to be a manageable way of integrating the safety-related roles of the Air Force and F M A S T, and – as the record attests – a very effective way to protect public safety. The F M A S T has also successfully drawn upon EWR 127-1 in the licensing of launches from non-federal ranges. It has issued multiple launch specific licenses to several providers and one operator license to Sea Launch; all launch activities conducted pursuant to these licenses have occurred without incident to public safety. Given this history, we continue to be concerned about proposed changes unless it can be shown that such changes will result in an enhancement to safety or more efficient and less costly implementation of launch safety requirements. In the absence of such a showing, our strong preference is for continuation of the existing process for demonstrating compliance with established safety standards.

The industry's remarkable safety record is evidence that this approach is effective. Moreover, it is manageable, both from operational and cost perspectives. As was stated in our consolidated response to the *NPRM*, our overarching concern about the proposed safety regulations is that they would change the nature of the launch safety regime in a way that would have a severe negative impact on our operations and costs without enhancing safety or improving efficiency. Worse yet, these regulatory and licensing changes with significantly negative cost and operational impacts would be implemented at a time when the economic viability of the U.S. commercial space launch industry is threatened. Such burdens would damage the competitiveness of U.S. industry in two fundamental ways: (1) they would add costs that could make launch services too expensive to perform commercially; and (2) their existence would be used against us by our non-U.S. competitors who tell potential customers that U.S. Government-imposed rules preclude U.S. launch providers' from meeting their customers' needs.

Considering the current state of the commercial launch services market, our concern in this regard is even greater now than it was two years ago when the NPRM was issued.

To emphasize the cost impact of the proposed rules, and as part of our response to the *NPRM,* each company provided separate, detailed assessments of the NPRM's cost impact on our launch operations. At the September 6,2002, public meeting on the SNPRM, the F M A S T asked us to re-evaluate these analyses taking into account the propositions set forth in the *SNPRM.* We have done so, and, as explained further below, our assessments indicate that there will still be a substantial cost impact.

No Clear Benefit from this Rule

1. NO Meaningful Impact on Safety
   - No safety benefits associated with NRPM. Minimal, if any, benefits associated with SNPRM.
   - "The FAA does not expect there to be any change in safety benefits." NPRM at 63963.
   - "Although the FAA has not quantified the ... effects the proposed requirement would have ... it does believe that section 417.107(b) would yield some incremental safety benefits. SNPRM p. 49493. [emphasis added]
2. Negative Impact on Industry
   - $500M to $1B cost to implement and comply
   - Launch delays
   - Loss of competitiveness
3. Negative Impact on Government
   - Increased cost to DOD to implement existing range safety system
   - Increased administrative costs to FAA to duplicate existing range safety system
   - Increases to costs of government launches
   - Threat to assured access to space
4. Negative Impact on Economy
   - Loss of revenues

We are compelled to reiterate our view that the creation of a regulatory environment for launch safety that would severely economically impair the industry without yielding a corresponding benefit for the public, would be contrary to the letter and spirit of the CSLA and would furthermore undermine the longstanding national economic and security interests associated with U.S. space transportation capabilities. We also must emphasize that none of the companies participating in this consolidated response either today suggests, or has in the past stated, that the F M A S T does not have the legal authority to promulgate launch safety rules. We simply ask why now and why in this way? For whom does this rulemaking add any value?

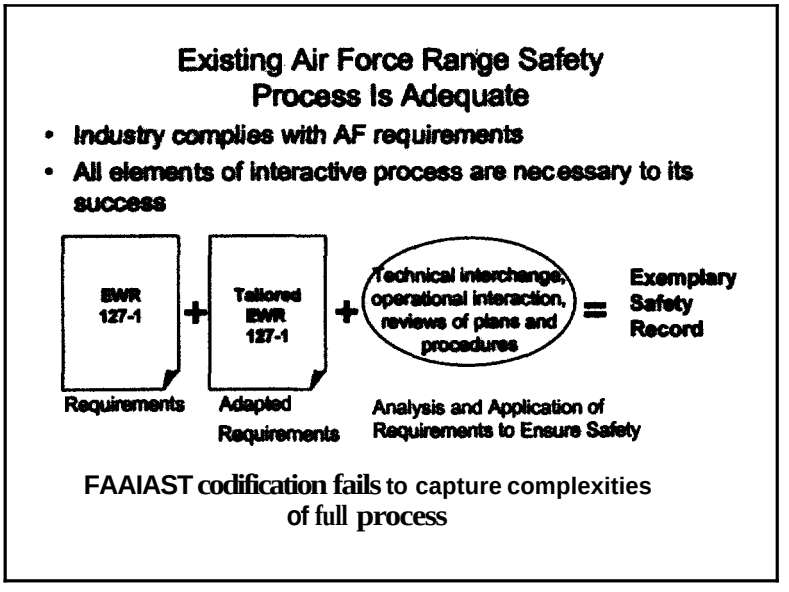
We can assure you it is not us – the industry that the FAA/AST is charged to support, promote, advocate and encourage. We submit that it also is not the public, because our operations already are imminently safe, as evidenced by our safety record. Indeed, the F M A S T itself admits that it does not expect there to be any change in safety benefits as a result of this rulemaking.[7] Regardless of the fact that, as the FAA/AST asserts in the **SNPRM,** launch operators' safety records can be used to demonstrate several truths – one such truth is unequivocal. All of our launch operations are safe. To our knowledge, no member of the public has suggested that our operations are unsafe or that they require further regulation and oversight. In fact, the proposed regulations could have a detrimental effect on the public, not from a safety perspective, but from an economic and national security perspective. That is, if for financial reasons, we, the members of the U.S. launch industry, cannot sustain our businesses, the negative impacts will impair our

[7] NPRM at 63963.

ability to provide the **U.S.** assured access to space on current terms. Considering the importance of assured access to space for national and economic security, this cannot be an acceptable resu t for anyone – not us, the public or the **U.S.** Government.

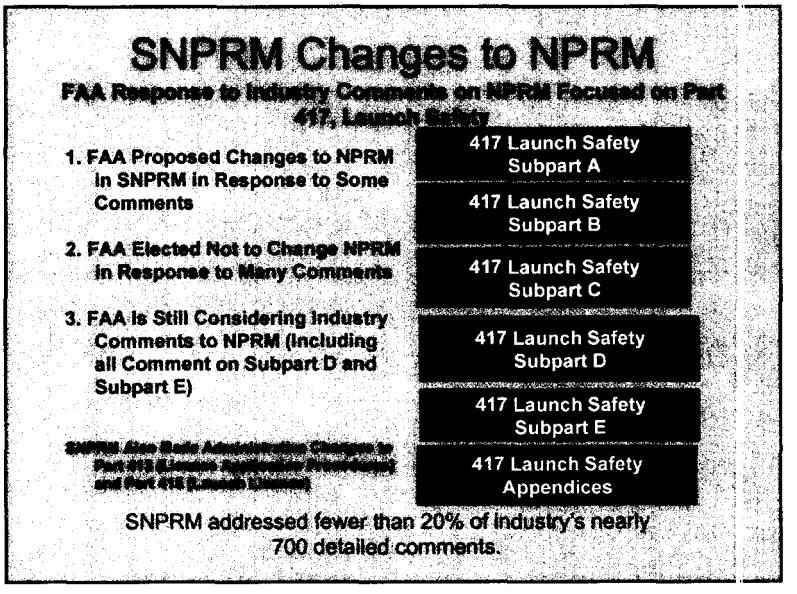
We also note that, in the SNPRM, the F M A S T states that an objective of this rulemaking is "codification" of existing launch safety requirements. Again, we ask why? To the best of our knowledge, no launch operator or member of the public has expressed any need to have the intent of the existing safety requirements and any range safety operations identified, clarified or codified. Nor are we aware of any claim that the existing safety requirements are confusing or inaccessible. **As** members of the industry who work with both the existing requirements and range safety operations on a daily basis, we believe the requirements are sufficiently clear and accessible. In fact, it is the proposed rule that, if implemented as drafted, would cause confusion, duplication and needless expense; all without any corresponding benefit.

Moreover, in continually restating its "codification" objective, the F M A S T has yet to evince understanding of one important source of industry concern: even if safety requirements, on paper, are the same as between the F M A S T and the Air Force, the process through which the requirements are imposed and compliance matters resolved, is fundamentally different.



Currently at the federal ranges, th: method of ensuring safety is through tailored, written safety requirements combined with a process of iterative and disciplined analysis of those requirements for each launch. Combining written requirements with analysis to support implementation is necessary to achieve safety goals. No stand-alone document can capture all eventualities or specify all requirements in a manner that is applicable to every launch and each specific vehicle. The implementation process – now a blend of operational interaction, technical interchange, and reviews of guidance documents, plans and procedures – is a vital element of the current range safety system. It is not an afterthought or **a** shortcut, but has, in fact, evolved over several decades of refinement of the range safety system. This process creates an environment in which extremely safe launch operations can be accomplished consistently. It also helps to ensure timely, reliable, and cost-efficient commercial launches. The introduction for commercial launches of another set of safety requirements, which would have its own format and means of implementation, would undercut the benefits derived from the evolution and refinement of the existing system.

The FAA/AST's proposal to codify range safety requirements in this manner fails to take into account the nature of the existing implementation process, and the fact that it will change fundamentally in the "translation" (*i.e.*, codification) to FAA regulations. The proposed regulations would transform a requirements document that demands technical analysis and interpretation ***in an iterative fashion*** in order to be applied into an inflexible rule with the force of law, implemented by a regulatory – not operational – government agency. The proposed rule would compromise the effective and efficient implementation process that is a necessary element of range safety.



We maintain today, as we have in other comments submitted in this proceeding, that, if promulgated as drafted, the FAA/AST's proposed rules and the associated regulatory implementation would have a severe negative impact on the **U.S.** launch industry – on both operational and cost levels – without providing any noticeable benefit to the public either in enhanced safety or in more efficient safety oversight.

IV. ISSUES CONCERNING THE SNPRM

The FAA/AST states in the SNPRM that comments on the October **25,2000** NPRM fall into three categories: **Category 1** consists of comments that caused the F M A S T to propose changes to the NPRM in the SNPRM; these changes applied primarily to Part 417 Subparts **A,** B, and C and to the appendices. **Category 2** consists of comments that did not result in changes, but did cause the FAA/AST to address commenters' concerns in the preamble to the SNPRM. This category encompasses many of industry's comments and concerns regarding Part 417, Subparts A, B, and C and to the appendices. Finally, **Category 3** consists of comments that the FAA/AST is still considering and will not address until the final rule. All of industry's comments on Part **417,** Subparts D and E fall into this category, as do the majority of our comments to the appendices.

As expressed at the September 6,2002 public meeting and set forth below, we have grave concerns with each of these three categories. We have provided a detailed analysis of commer ts falling into these categories in the table at the conclusion of this tabbed section, "Analysis of Issues Associated with NPRM as Modified by SNPRM." This table characterizes key issues of concern to industry, specifying changes from current practice that would be required under the NPRM as modified by the SNPRM, and tracking the change in the issue from the NPRM to SNPRM.

1. Category One – Proposed Changes to the NPRM

Industry recognizes that the F M A S T attempted to resolve some of the issues identified in the NPRM through the FAA/AST's proposed method of grandfathering previously accepted altemative approaches to meeting range safety requirements. However, the limitations and restrictions placed on grandfathering proposed by the F M A S T are so extensive that this proposal does not solve the problems addressed in the NPRM.

While the FAA/AST states that its intent is to avoid unnecessary duplication of the range safety process and to accept range safety approvals, in fact there are few, if any, launches for which this would be the case under the provisions of the proposed rule. For example, the proposed method of grandfathering requires that, for any instance in which the operator does not comply with the FAA/AST's rule, that the operator have a waiver or a meets intent certification from the range. This requirement alone would generate a substantial amount of unnecessary paperwork. The range safety process includes technical interchange and operational interactions that conclude in an overall flight plan leading to launch approval. In this instance, no specific formal waiver is written for requirements that the range safety organization has determined can be handled on a less formal basis. Under the F M A S T's proposal, written waivers would have to be obtained from the range safety organization for each element of the F M A S T's rule that fell into these categories. Further, the Air Force range safety organization currently determines whether modified or altemative technical approaches meet safety objectives; under the proposed rule, the operator would also have to separately provide a "clear and convincing demonstration" of this to the FAA/AST.[8]

Grandfathering Proposed by FAA/AST is Too Restrictive

- **Requires new documentation**
- **Approach is limiting**
- **Narrower applicability**

This Approach is Ineffective

[8] SNPRM **at 49497, Part 417, Subpart C—Flight Safety Analysis, § 417.203 Compliance. (c) Alternate analysis. The FAA will approve an alternate flight safety analysis** if **a launch operator provides a clear and convincing demonstration that** its **proposed analysis provides an equivalent level of safety to that required by this subpart.**

Category One – Proposed Changes to the NPRM

NPRM/ SNPRM	Industry Issue	SNPRM Change from NRPM	Analysis
Subpart A	Need to continue effective Air Force (AF) practice of grandfathering	SNPRM includes limited version of grandfathering by the FAA/AST; none in NPRM	**Problem not resolved:** Limits imposed (new documentation, time restrictions, narrower applicability) make proposed approach to grandfathering ineffective
Subpart C	Transfer of responsibility for launch analysis for each launch from range to operator	Allows operator to contract with range to provide analysis; permits reports for classes of launches	**Problem partially resolved:** While SNPRM doc address concerns regarding requirement that operator conduct analysis now conducted by range, FAA/AST still requires that operator com with provisions of rule based on range safety organization's analysis, where operator has no ability to control or affect the conduct of that analysis. SNPRM resolves issue of reports for single versus multiple launches
	New methodologies and data	No substantive change	**Problem not resolved:** Some requirements moved to Appendix, but still have force of law, s have cost impacts; these changes do not meet FAA/AST's stated intent of performance-based rule
	More restrictive standards and thresholds	No substantive change	**Problem not resolved:** Some requirements moved to Appendix, but still have force of law, s have cost impacts; these changes do not meet FAA/AST's stated intent of performance-based
	Changed standards for toxic hazards	impact	
	Duplicative reporting requirements	No change	**Problem not resolved:** Subpart C continues tc impose duplicative reporting requirements to bo AF and FAA/AST
	Neighboring launch operator	Introduces issues of treatment of neighboring launch operator personnel for risk assessment purposes	**Potential problem:** Changed risk calculation methodology with unclear impact due to insufficient information

SNPRM fails to resolve the problems identified in NPRM.

As mentioned earlier, the FAA/AST's proposed approach to grandfathering is severely limited." Only those launches licensed at the time the rule is promulgated would be grandfathered, while launch activities requiring new licenses (or presumably expanded licenses) must separately comply with both F M A S T and Air Force requirements, creating a costly and unnecessary duplication of effort.

We also recognize the F M A S T, through the SNPRM, states that launch operators are no longer required to independently conduct safety analysis in accordance with Subpart C. Rather, the launch operators would now be allowed to contract with the federal ranges for this service. However, by moving the technical requirements for this safety analysis previously addressed in Subpart **C** of the NPRM to Appendix A in the SNPRM as part of its attempt to make these requirements more performance-based versus prescriptive, the F M A S T has placed the launch operator in a position **of** ensuring that the federal range performs safety analysis in a manner prescribed by the rule. Industry has no oversight authority or control over how the federal ranges conduct safety analysis, which they have accomplished successfully for over **40** years, thereby placing the launch operators in a position of jeopardy of non-compliance. Industry is also concerned that if the requirements dictated in Appendix A for safety analysis are codified, the cost of range services could increase in order to satisfy analysis required by the F M A S T but not required by the federal range.[9]

Finally, it should be noted that the SNPRM raises new issues. The SNPRM changes application of toxic hazard thresholds from aggregate to individual, which provides some relief from the related NPRM provision, but the impact of this change is still unclear. In addition, the SNPFW changes debris thresholds and the methodology for toxic hazard analysis, requiring new analysis with unclear impacts. It also introduces the issue of potentially modifying the treatment of neighboring launch operator personnel for risk assessment purposes. After considering the FMAST's discussion on this point, industry finds that the current approach to the treatment of neighboring launch operator personnel (even with regard to the differing approaches purported y taken vis-&vis the 30th and the 45th Space Wings) should be maintained **as** is for two main reasons: (1) industry lacks insight into the **risk** calculation methodologies or philosophies being, used to assess any changes to the current approach; and **(2)** there has not been a substantial opportunity to discuss concerns with respect to this issue in more detail and in more depth. Consequently, it is impossible for industry to determine the implications of any change to the current approach, much less determine any potential cost impacts or issues relating to the availability (and cost) of insurance. Based on the information provided in the ***SNPRM,*** industry's preliminary assessment of this matter is that any change to the current approach to the treatment of neighboring launch operator personnel, including the imposition of a cross-waiver requirement, could impose on industry and its customers undue and burdensome administrative and logistical requirements, place critical schedules and programmatic activities at risk, and adversely impact the cost or availability of insurance.

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[9] **See SNPRM at 49460-461.**

[10] **See SNPRM** at **49464 (debris threshold) and 49492** (toxic **hazard analysis).**

2. Category Two – Comments that did not Result in Changes to the NPRM

Our concern with respect to this category is that we do not believe that the very serious issues that were raised by the industry in response to the NPRM have been adequately addressed in the SNPRM. We note, for example, that there remains a profound difference between the FAA/AST's view and industry's view of the cost impact of the proposed requirements. More specifically, we still have significant cost concerns associated with extensions to launch processing timelines, short term schedule delays, and the increased potential for significant program disruption as detailed in our cost impact analyses.

The FAA/AST's economic assessment of the NPRM indicated the cost impact to be insignificant. This estimate has changed minimally with the SNPRM. The SNPRM modification to include a more stringent toxic hazard threshold resulted in the FANAST estimating the total cost impact to industry for implementation of both the NPRM and SNPRM to be $700,000. This estimate represents the cost impacts of scrubbing two launch attempts during the five-year period.

Industry's assessment of the cost impact to achieve compliance with the regulations as proposed in the NPRM fell between $500 million and $1 billion over a five-year period. Industry provided its estimate as a range for two reasons. First, the estimate reflects both impacts that are easily quantified as well as significant impacts that cannot be estimated with precision, in many cases because the proposed rule provides insufficient information or introduces uncertainties. Second, a range was necessary to enable the industry to communicate the magnitude of the impacts while protecting proprietary data. Detailed cost estimates based on proprietary data were submitted by companies individually to the FANAST as part of comments to the NPRM. Individual, proprietary company cost estimates also are being submitted as part of comments to the SNPRM.

The cost impacts associated with the proposed rule as supplemented by the SNPRM remain in the same $500 million to $1 billion range. While the SNPRM yields some variation in costs, including both increases and, in a few cases, decreases, the net effect is minor and does not lead to any significant per mission cost reduction. However, dramatic changes in the launch market – with annual launch forecasts dropping by 50% or more – have the effect of driving total cost impacts toward the lower end of this range. As a result, any decrease in the cost impact to industry is due to a reduced commercial manifest rather than any savings benefits of the SNPRM.

Moreover, we note that industry already has expended in excess of the FAA/AST's projected total cost impact of $700,000 in our support of the rulemaking effort over these past two years. The fact that the F M A S T still disagrees with industry on the cost impact of the proposed rule by such a significant amount after more than two years of this rulemaking process portends the magnitude of the problem.

NPRM/ SNPRM	Industry Issue	SNPRM Change from NRPM	Analysis
Subpart A	Inflexible launch plan due dates	No change	**Problem not resolved:** Inflexible due dates do not reflect availability of data; could cause schedule slips
Subpart B	Expanded launch rehearsals	No change	**Problem not resolved:** Scope of launch rehearsals expanded to include anomalous as well as nominal launches; significant expansion in scope
	Personnel	No change	**Problem not resolved:** Detailed requirements for positions and personnel experience will require hiring new staff and make qualifying difficult
	Surveillance	No change	**Problem not resolved:** Need for surveillance may arise out of hard-to-verify downrange data specifications

Clearly, there is a significant and fundamental disconnect between government and industry on the cost impact of the proposed regulations. The SNPRM discounts many of the cost concerns expressed in our cost impact analyses submitted in response to the NPRM. Such dismissal *is* supported by the assertion that the F M A S T is not imposing any new requirements, but is merely restating existing requirements in a way that, the F M A S T surmises, the industry does not understand. If, as the FAA/AST suggests, there is a misunderstanding on industry's part, the gap between the two understandings is so significant that we are compelled to respectfully **ask** the F M A S T to explain its methodology further so that we can come to a common understanding on how the F M A S T intends to apply the rules and how **risk** will, in fact, be calculated. It is obvious that to better understand this discrepancy, further dialogue is essential Proceeding directly to a final rule (as is currently proposed in the SNPRM) without fully vetting industry's concerns would put us in an untenable position. We do not believe that this is the FMAST's intent.

3. Category Three – Comments that the F M A S T is Still Considering

In industry's consolidated response to the NPRM, we provided nearly 700 detailed technical comments, less than 20% of which are addressed in the SNPRM. The SNPRM provides feedback on some of our comments to Part 417 Subparts A, B, and C and Appendix A, but did not address any comments to Subparts D, E, and seven other appendices. Disposition of the vast majority of comments is not tackled in the SNPRM other than to state that the FAA/AST intends to address them in the final rule. This approach is neither useful nor productive. In fact, this approach by the F M A S T raises several concerns with respect to this category.

Category Three – Industry Comments to NPRM that the FAA/AST is Still Considering

Industry comments on Subpart D and Subpart E (below) are still under consideration by the FAA/AST, which has expressed its intent to address these comments in the final rule it plans to issue in Spring 2003.

NPRM/ SNPRM	Industry Issue	SNPRM Change from NRPM	Analysis
Subpart D	Expanded requirements and new standards for flight termination systems (FTS)	No change	Problem not resolved; was not addressed in SNPRM: Inappropriate level of technical specificity in NPRM results in unworkable or inapplicable requirements
Subpart E	Additional administrative licensing requirements and inflexible due dates for changes to ground safety plan	No change. Was not addressed in SNPRM	Problem not resolved; was not addressed in SNPRM: Routine changes may result in significant administrative costs (due to license changes) and may even cause schedule slips
	Additional ground safety analysis (including "any and all" hazards and 'non-credible" hazards)	No change. Was not addressed in SNPRM	Problem not resolved; was not addressed in SNPRM: Requirement impossible to meet: identify all hazards, non-credible hazards. Will create uncertainty regarding compliance, implementation
	Expanded hazard control requirements	No change. Was not addressed in SNPRM	Problem not resolved; was not addressed in SNPRM: Changes to current operational procedures increase process timeline with no safety benefit
	Duplicative reporting requirements	No change	Problem not resolved; was not addressed in SNPRM: Subpart E continues to impose duplicative reporting requirements to both AF and FAA/AST

The short time frame and rulemaking constraints on communication with industry will prevent effective resolution of these complex issues in a final rule.

First, if the category 1 and 2 comments represent the easier issues that nevertheless have taken the F M A S T over a year of diligent effort to review and deliberate in order to release the SNPRM, then resolution of our chief concerns is a long way away. The fact is that the remaining compilation of comments contains the more challenging issues carrying more significant cost, technical, and operational implications. We believe it is unrealistic to presume these tough issues (as well as the additional issues raised by industry comments to the SNPRM) can be appropriately addressed without further extensive information exchange with industry. It is thus our conclusion that the communication-restrained, deadline-driven environment of a rulemaking proceeding is not the appropriate forum for tackling these highly complex, technical issues in the absence of a compelling reason to do so, which has not yet been articulated.

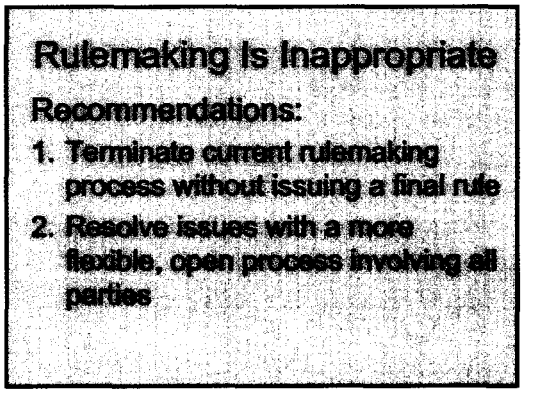
Second, we note that the F M A S T is consulting with the Air Force through the Common Standards Working Group identified in the ***SNPRM*** on these tough unresolved issues. More specifically, the F M A S T explains that the Common Standards Working Group is participating in developing the F M A S T's final rule."[11] Through the Common Standards Working Group, the F M A S T and the Air Force are sharing ideas and experiences on range safety issues. It is upon this exchange that updates and refinements to safety requirements, which will be applied to industry's launch operations, will be based. Considering the significant impact of this activity on industry, we would expect, at a minimum, to have insight into this effort. Notwithstanding our fundamental concerns with this rulemaking process, if the FAA/AST and the Air Force have determined that the Common Standards Working Group is to be a government-only group, then we believe that there needs to be another open channel for industry communication with the F M A S T and the Air Force on these issues, especially if the F M A S T intends to produce a final rule based in no small part on its exchanges with the Air Force. We submit that failure to provide industry this insight and opportunity for meaningful interaction in this process could be construed as inconsistent with the principles of the Administrative Procedure Act.

Third, the fact that major substantive issues are still being addressed with their disposition planned for a final rule, raises serious concerns about F M A S T's consideration of cost impacts in its decision-making process. How will the cost impacts of the requirements that the FAA/AST and the Common Standards Working Group are still developing be determined? It appears that industry will have no opportunity to estimate these cost impacts and provide that information to the F M A S T to support its decision-making, or even to comment on the F M A S T's estimate,; of these cost impacts prior to the publication of a final **rule.**

[11] **SNPRM** at 49471.

V. CONCLUSION

It is appropriate for the government to maintain, revise and update federal launch safety requirements and we appreciate agencies working together to do so. However, the current rulemaking process creates constraints that are impeding rather than advancing that effort. These constraints are resulting in technical inaccuracies and misunderstandings, the creation of a duplicative system, and the imposition of substantial costs on industry, while achieving no meaningful safety benefits. This situation suggests to us that, in hindsight, initiation of this rulemaking proceeding by the F M A S T was inappropriate.



A better approach is to address technical launch safety requirements outside the confines of the rulemaking process, with iterative dialogue and interactive problem-solving among all affected parties. To ensure that the F M A S T's safety objectives continue to be met, the documented results of this collaborative process could be incorporated by reference into FMAST-issued launch licenses, as is the case with EWR 127-1, and could also be used as the basis for future rulemaking activity.

To this end, industry recommends the indefinite suspension or termination of the current rulemaking process. A more flexible, open process that facilitates technical interchange and the building of shared understanding will better serve the F M A S T, the Air Force, the public and the **U.S.** launch services industry.

October **28,2002**

Analysis of Issues Associated with NPRM as Modified by SNPRM

Title	Comment Category	Change from Current Practice	Change from NRPM	NPRM as modified by SNPRM Subpart/Section(s)
Change in grandfathering policy	Category 1: Comments that caused the FAA/AST to propose changes to the NPRM in the SNPRM	More restrictive version of grandfathering than currently used at ranges: time limited, requiring additional documentation, narrower application. Limits imposed make proposed approach to grandfathering ineffective	SNPRM includes limited version of grandfathering by the FAA/AST; none in NPRM	Part 417, Launch Safety, Subpart A – General § 417.1
Inflexible due date for launch plans and ground safety plans	Category 2: Comments that did not result in changes	Specification of inflexible due date for launch plans and ground safety plans	No change	Part 417. Launch Safety, Subpart A – General, § 417.9 Safety review document and launch specific updates, § 417.11 License flight readiness
Changed organizational structure and personnel qualifications	Category 2: Comments that did not result in changes	Changes in organization structure and personnel qualification requirements addition of positions required on licensee team and more stringent personnel qualification standards	No change	Part 417, Subpart B . . Launch Safety Requirements, § 417.103(b) Launch operator organization , § 417.105 Launch personnel qualifications and certification
Surveillance of established hazard areas	category 2: Comments that did not result in changes	Requirement to conduct surveillance of established hazard areas	Administrative changes (11, 12); no substantive change except as affected by grandfathering provision	Part 417, Subpart B - Launch Safety Requirements, § 417.113 Launch safety rules (b) Flight commit criteria
Expanded launch rehearsals	Category 2: Comments that did not result in changes	Expanded scope of launch rehearsals	No change	Part 417, Subpart B - Launch Safety Requirements, § 417.119 Rehearsals (a)6,c
New value for calculating launch probability	Category 1: Comments that caused the FAA/AST to propose changes to the NPRM in the SNPRM	Specification of new value for calculating overall launch probability	Administrative change renumbering section from 417.227 to 417.225 (26) and moving specification of launch vehicle failure probabilities to A417.25. No substantive change except as affected by grandfathering provision	Part 417, Subpart C - Flight Safety Analysis, Appendix A to Part 417 Flight Safety Analysis Methodologies and Products, § 417.225 § A417.25 Debris Risk (b) Debris risk analysis constraints 5 (i),(ii), (iii)

Title	Comment Category	Change from Current Practice		SNPRM Subpart/Section(s)
Operator made responsible for analysis now conducted by range safety organization	Category 1: Comments that caused the FAAJAST to propose changes to the NPRM in the SNPRM	Launch operator no longer required to conduct analysis; rule requires an analysis be conducted, and specifies range conducted analysis as acceptable (if contracted for with range and approved in baseline assessment) Changes reference to "public risk criteria' with which flight safety analysis must comply to 'performance criteria;" moves specific criteria into Appendix A	Launch operator no longer required to conduct analysis; rule requires an analysis be conducted, and specifies range-conducted analysis as acceptable (if contracted for with range and approved in baseline assessment) Changes reference to "public risk criteria" with which flight safety analysis must comply to 'performance criteria;" moves specific criteria into Appendix A.	Part 417, Subpart C - Flight Safety Analysis
Individual launch rather than dass reports	category 1: Comments that caused the FAAJAST to propose changes to the NPRM in the SNPRM	No change from current practice, if range satisfies FAA via baseline assessment and that "contracting" with range describes current practice	Requirement that flight safety analysis and debris risk analysis reports be submitted for each launch (rather than a series of launches) changed in SNPRM to allow for use of analysis from previous launches or to accept federal range flight safety analysis	Part 417, Subpart C .: Flight Safety Analysis, § 417.201 Scope, § 417.203 Compliance (a) General, (b) Method of Analysis, (c) Alternative analysis, (d) Analysis performed by a federal range
Inflexible due dates for flight safety analyses	Category 1: Comments that caused the FAAJAST to propose changes to the NPRM in the SNPRM	Timing requirements for submitting analysis products to the FAA – 6 month analysis, 30 day analysis	30 dav analysis not required if 6 month analysis is not changed. Flight safety analysis may rely on an earlier analysis from and identical or similar launch if the analysis still applies to the later launch	Part 417. Subpart C - Flight Safety Analysis, § 417.203 Compliance (a) General (e) (2) Six-month analysis, (3) Thirty-day fliaht safety analysis update (4) Programmatic fliaht safetv analvsis
New wind data	Category 1: Comments that caused the FAAIAST to propose changes to the NPRM in the SNPRM	Requirement to provide wind data not currently provided	No change	Part 417. Subpart C - Flight Safety Analysis, Appendix A to Part 417 Flight Safety Analysis, Methodologies and Products § 417.207 Trajectory analysis (c) Wind effects, § A417.7 (g) Traiectow analvsis products (3) Wind profile(s)
Changed trajectory coordinate system	Category 1: Comments that caused the FAAIAST to Propose changes to the NPRM in the SNPRM	Requirement to provide trajectory coordinates using a right-handed coordinate system	No change	Part 417, Subpart C - Flight Safety Analysis, § 417.207 Trajectory analysis (c) Wind effects, § A417.7 (g) Traiectow analvsis products (7) Temporal trajectory items

Title	Comment Category	Change from Current Practice	Change from NRPM	NPRM as modified by SNPRM Subpart/Section(s)
Additional debris data	Category 1: Comments that caused the FAA/AST to propose changes to the NPRM in the SNPRM	Requirement to provide additional data to support debris analysis beyond what is currently required	No change	Part 417. Launch Safety, Subpart C Flight Safety Analysis, Appendix A to Part 417 Flight Safety Analysis Methodologies and Products, § 417.21 Debris analysis, § A417.11 Debris (b) Debris analysis constraints
New debris analysis methodologies	Category 1: Comments that caused the FAA/AST to propose changes to the NPRM in the SNPRM	Requirement to incorporate new methodologies for fragment imparted velocity and fragment effective casualty area into debris modeling	No change	Part 417. Launch Safety, subpart C Flight Safety Analysis, Appendix A to Part 417 Flight Safety Analysis Methodologies and Products, § 417.21 Debris analysis, § A417.11 Debris (c) Debris model
New FTS independence requirement	Category 3: Comments that the FAA/AST is still considering and will not address until the final rule	Requirement that flight termination system not share any cabling or any other component with any other launch vehicle system	No change	Part 417. Launch Safety, Subpart D Flight Safety System, § 417.305 Flight termination system reliability (d) System independence
New FTS monitoring requirement – launch	category 3: Comments that the FAA/AST is still considering and will not address until the final rule	New requirement to monitor each predicted component environment rather than general area environments for the first four flights of a new launch vehicle	No change	Part 417, Launch Safety, Subpart D . Flight Safety System, § 417.307 Flight termination system environment survivability (b) Maximum predicted environments (2)
New FTS monitoring requirement – shipping	category 3: Comments that the FAA/AST is still considering and will not address until the final rule	New requirement to monitor the environment of packaged FTS components during shipping, handling, and transportation	No change	Part 417, Launch Safety, Subpart D . Flight Safety System, § 417.307 Flight termination system environment survivability (b) Maximum predicted environments (3)
New safe/arm requirement	Category 3: Comments that the FAA/AST is still considering and will not address until the final rule	Requirement to ensure that the Inertial Navigation Unit used on Atlas to control safe/arm of the Solid Rocket Motor jettison functions is single fault tolerant	No change	Part 417, Launch Safety, Subpart D . Flight Safety System, § 417.313 Flight termination system safing and arming (d) In-flight safing (1)
Additional FTS component tests	Category 3: Comments that the FAA/AST is still considering and will not address until the final rule	Additional qualification and acceptance test requirements for flight termination system components	No change	Part 417. Launch Safety, subpart D Flight Safety System, § 417.315 Flight termination system testing (a) General

Title	Comment Category	Change from Current Practice	Change from NRPM	NPRM as modified by SNPRM Subpart/Section(s)
New FTS reporting requirement	Category 3: Comments that the FWAST is still considering and will not address until the final rule	New requirement to submit a summary report of acceptance test data for FTS systems	No change	Part 417. Launch Safety, Subpart D Flight Safety System, § 417.315 Flight termination systen testing (f) Test reports (2) Acceptance, ag Surveillance, and prefliaht test reports
New time limit on FTS test validity	Category 3: Comments that the FWAST is still considering and will not address until the final rule	New 10-day time limit set on the validity of pre-flight test results for flight termination system safe and arm device	No change	Part 417. Launch Safety, Subpart D Flight Safety System § 417.317 Flight termination system preflight testing (d Prefliaht testina of safe and arm devic that has an internal electro-explosive device (1) and (h) Preflight subsystem and system level tests (3)
New FTS reliability analysis requirement	category 3: Comments that the FWAST is still considering and will not address until the final rule	New requirement to perform a sneak circuit analysis as part of the reliability analysis of the flight termination system and the command control system and to modify FTS components	No change	Part 417, Launch Safety, Subpart D Flight Safety System, § 417.329 Flight safely system analysis (b) System reliability analysis
Inflexible due date for ground safety plan changes and new license requirement	Category 3: Comments that the FWAST is still considering and will not address until the final rule	Specification of inflexible due date for submittal of ground safety plan changes and the requirement that some changes be submitted as a license modification	No change	Part 417, Launch Safety, Subpart E Ground Safety, § 417.403 General (:) Ground safety plan
Additional ground safety analysis	Category 3: Comments that the FWAST is still considering and will not address until the final rule	Requirement for substantially increased level of detail in ground safety analysis (including "any and all" hazards and hazard controls, employee hazards and non-credible hazards) and requirement for a new ground safety analysis for existing systems	No change	Part 417, Launch Safety, Subpart E .. Ground Safety, § 417.405 Ground safety analysis (a), (g), (f)
Expanded requirement to track hazards	Category 3: Comments that the FWAST is still considering and will not address until the final rule	Requirement to track all hazards (expanding on current requirement to track public hazards) and requirement to conduct daily inspections rather than conduct inspections at time intervals that are appropriate for a specific system	No change	Part 417, Launch Safety, Subpart E · Ground Safety, § 417.407 Hazard control implementation (b) Hazard control verification. (d) Inspections
New ordnance requirement – connections	Category 3: Comments that the FWAST is still considering and will not address until the final rule	New requirement to keep all ordnance and electrical connections disconnected until final preparations for flight	No change	Part 417, Launch Safety, Subpart E · Ground Safety, § 417.409 system hazard controls (e) Ordnance systems. (1)

Title	Comment Category	Change from Current Practice	Change from NRPM	NPRM as modified by SNPRM Subpart/Section(s)
New ordnance requirement – safing and arming	Category 3: Comments that the FWAST is still considering and will not address until the final rule	New requirements for safing and arming requirements of all ordnance, expanding beyond current compliance for Category A ordnance	No change	Part 417. Launch Safety, Subpart E Ground Safety, § 417.409 System hazard controls (f Ordnance systems
Changed standards for toxic hazards	Category 1: Comments that caused the FWAST to propose changes to the NPRM in the SNPRM	Changed application of toxic hazard thresholds from aggregate to individual; impact unclear	Provides some relief from NPRM provision, but impact is unclear	Part 417, Launch Safety, Subpart B Launch Safety Requirements, §417.107 Flight safety (b), (c) (1), Subpart C Flight Safety Analysi 417.227 Toxic relea hazard analysis
Changed debris thresholds and methodology for debris hazard analysis	Category 1: Comments that caused the FWAST to propose changes to the NPRM in the SNPRM	Changed debris thresholds and methodology for debris hazard analysis	Changes threshold for debris hazard analysis methodology to require kinetic energy rather than ballistic coefficient. For explosive debris, changes standard from 3 psi to 1 psi	Part 417, Launch Safety, Subpart B Launch Safety Requirements, §417.107 Flight safety (b), (c) (1), Subpart C Flight Safety Analysi 417.225 Debris ris analysis
Neighboring Launch Operator	Category 1: Comments that caused the FWAST to propose changes to the NPRM in the SNPRM	Changed risk calculation methodology with unclear impact due to insufficient information	Introduces issues of treatment of neighboring launch operator personnel for risk assessment purposes	Preamble

SNPRM Preamble Section	Comments
Changes to October 2000 Proposal	
A. Grandfathering	
Although the proposed requirements are derived from existing range requirements, there are, for any number of different reasons, launch vehicles and launch operators who would not comply with the requirements as proposed in the NPRM. For example, in the NPRM, the FAA noted that there might be instances where the ranges had granted waivers to the requirements of Eastern and Western Range 127-1, Range Safety Requirements ("EWR 127-1"). NPRM, 65 FR 63941. Additionally, the FAA recognizes that there are launch operators operating under older versions of EWR 127-1 who would not meet current federal range standards or, therefore, the proposed FAA requirements. In the NPRM, the FAA noted that launch operators might experience cost impacts from bringing their operations into compliance with the proposed requirements, and requested comments on the FAA's plan not to "grandfather" such noncompliances.	
The FAA received comments suggesting that, in addition to existing waivers, other candidates for grandfathering exist. JC Vol. I at 9. The comments noted that the ranges grandfather sub-systems on launch vehicles that become non-compliant when the ranges implement new safety requirements. Additionally, comments called the FAA's attention to the ranges' "tailoring" process, by which a range determines whether a launch operator's proposed alternative, although not compliant with the letter of the range requirements, nonetheless meets the intent behind the requirement. Commenters urged the FAA to accept existing tailoring agreements. For all these scenarios, including waivers, tailoring and existing range grandfathering arrangements, launch operators urged that the FAA "grandfather" current launch systems. Launch operators urged cost and range practice as the reasons for grandfathering. The FAA is considering adopting some of the suggestions contained in the comments to this rulemaking, but requests additional comment and information in light of the considerations discussed below.	
1. Applicability and effective dates of requirements	
Commenting launch operators requested that the FAA provide more detail regarding how and whether grandfathering would work. The FAA specifies an effective date for each rule promulgated. There are a number of options for determining an effective date. A rule might apply, for example, to all launches that took place after a certain date, regardless of when the launch vehicle was designed or built. Usually, for such a decision an agency would provide a fairly lengthy lead-time. Alternatively, a rule might apply to all	We suggest that this rule only become effective for launch vehicle configurations or families not currently in existence (i.e. if Delta V or Atlas VI come into existence) This discussion pertains to two topics: Use of term grandfathering and associating effective dates in this process. **Rationale for retaining the use of term "grandfathering":** We are deeply disappointed with the position of FAA not to use the term

SNPRM Preamble Section	Comments
launch vehicle components manufactured after a certain date. Again, a lengthy lead-time might be ncccssary to allow a licensee to incorporate any changes into its design and subsequently manufactured hardware. Finally, in accordance with Department of Transportation and FAA usage, the FAA's proposed regulatory requirements will not employ the term "grandfather," but will, instead, describe how and when part 417 would or would not apply.	"grandfathering". This negates the FAA claim that the FAA requirements are derived from existing Range regulations. Not to accept a tcrm that has been a comer stone in the proven Air Force process and trying to create other means and restrictions by itself is a process leading to confusion and costly misinterpretations. It is a widely used industry term and not using it will create a basic incompatibility to the practice. FAA has not provided a reasonable explanation of why they cannot use the term other than saying it is not in their usage. Fundamentally the tcrm means nothing more than "accepting previous decisions unless there is a significant material change in risk". We believe there is nothing wrong with the term usage or the concept developed and implemented by Air Force. We request FAA to reconsider their position. Rationale for not associating effective dates in grandfathering process: We also disagree with the **FAA** position that a specific effective date is needed to be tied to grandfathering decisions. Grandfathering is a key process that should continue, irrespective of time, as long as the launch vehicles keep evolving. Clearly, there should a door open to use successful products of the past unchanged to continue the evolved design approach. A quick glance at the history of rocket development will clearly establish this evolutionary nature. If FAA continues its position to not use the term grandfathering, associate effective dates and start creating alternate approaches with restrictions or complicated verbiage, it should be recognized that it will clearly lead to the suppression of this evolutionary process, kill the grandfathering concept as it is practiced today and affect the future developments and competitiveness of this industry. We urge FAA to take a flexible approach and reconsider adapting the term "grandfathering" and implement it the way Air Force has successfully done for many years at the non-federal ranges as well. We are convinced that the alternate paths proposed at the federal ranges, however convincing it may seem on paper, will impede independent decision by Air Force and cause irreversible damage to one of the most successful elements of the Air Force Range Safetv Drocess.
For ameets intent certification or noncompliance to qualify under the FAA's proposed version of grandfathering, the federal range approval of such relief from a safety requirement would have to exist as of the effective date of proposed part 417. The FAA intends to allow sufficient time between the issuance of the final rule and the date that part 417 would become effective for federal ranges to make decisions on pending requests for relief that might be in work **at** the **time a** final FAA rule is issued. For launches from Air	Suggest existence of grandfathcring be demonstrated by existing, current practice – instead of the requirement for formal documentation. Much of the "grandfathering" is not formally documented. This discussion pertains to instituting certain time limits and establishing a joint relief process. **Kationaie for not imposing time restrictions in the grandfathering**

SNPRM Preamble Section	Comments
Force rangcs, thc Air Force and the FAA intend to have the joint relief process, discussed in section IV.C of this supplemental notice, in place prior to the effective date of part 417. This will allow for a smooth transition from pre-existing Air Force relief approvals that would qualify for the FAA's proposed version of grandfathering, to the joint process that will be used to resolve future requests for relief from launch safety requirements.	**process:** We disagree with the FAA position to set a date for limiting the meets intent certifications and noncompliances. The process of grandfathering is not limited and bound by a collection of approved papers but is a living process that comes up many times on all programs at all levels of the launch vehicle that may or may not require documentation. Such a process was not without reason. Air Force has partnered with the industry and through their insight fostered an approach with minimum paperwork. The grandfathering itself has been in practice long before the arrival of EWR 127-1. The predecessor to EWR 127-1, ERR 127-1/WRR 127-1, started the intensive tailoring process. Prior to this time there was none or very limited tailoring. Stages, systems, components and process were grandfathered without unnecessary paperwork and therefore there is no documentation. Grandfathering are also granted many times through design reviews and technical interchanges. **Rationale for not needing a <u>new</u> relief process:** We are fully convinced that there is no need for a new version of grandfathering. There simply is nothing wrong with the Air Force process. If Air Force is allowcd to continue the current process at the federal ranges, there is no issue and there is no need for a relief process. FAA has reiterated many times it intcnds to accept range process but has also been proposing new versions to proven Air Force policies. We applaud such creative thought process and wc arc not against change. Our experience with Air Force has been a process of implementing change through an evolutionary process rather than promulgating a rule and measuring the consequence. The grandfathering process itself is a mitigation in such a changing world. Air Force has issued many versions of regulations: AFTERM 127-1, ESMCR 127-1, WSMCR 127-1, ERR 127-1, WRR 127-1, EWR 127-1 (a version every couple of years). How did our launch vehicle development survived through all this?. The answer lies in thc grandfathering process. It is for this reason we are deeply perturbed and request FAA to leave the Air Force grandfathering process unchanged. Therefore we request FAA to let the Air Force process continue at the federal ranges as it exists todav.
2. Range approach to implementing new safety requirements	
At the Air Force s launch ranges, EWR 127-1 governs. The Air Force s	

SNPRM Preamble Section	Comments
range safety organizations periodically update these requirements, and determine the extent to which those updates will affect existing launch vehicles and systems. Commenting launch operators noted that "the existence of such new requirements does not necessarily make an existing system unsafe or expose the public to greater safety risks." JC Vol. I at 9. EWR 127-1 recognizes this, and grandfathers and maintains the approvals of previously approved systems unless the Chief of Safety or the launch operator determines one of the following:	
a. Existing programs make major modifications or include the use of currently approved Components, systems, or subsystems in new application (through tailoring if desire[d]) Exception: Previously approved existing components, systems, or sub-systems that do not increase the risks, do not degrade safety, or can survive new environments [that] are equivalent to or lower [lcss severe] than the originally approved qualification levels shall be honored and do not have to meet new requirements [do not have to be upgraded] as long as data and analyses show that the criteria have been met.	
b. The Range User has determined that it is economically and technically feasible to incorporate new requirements into the system.	
c. The system has been or will be modified to the extent safety approvals no longer apply. NOTE: Risk and hazard analyses developed jointly by Range Safety and the Range User shall be used to determine applicability of the safety approvals.	
d. A previously unforeseen or newly discovered safety hazard exists that is deemed by either Range Safety or the Range User to be significant enough to warrant the change.	
e. The system does not meet the requirements existing when the system was originally accepted. NOTE: This category includes systems that were previously approved, but when obtaining the approval, the noncompliances to the original reauirement were not identified.	
f. A system or procedure is modified and a new requirement reveals that a significant risk exists.	
g. Accident and incident investigations and reports may dictate compliance with the document. EWR 127-1, Appendix 1C, 1C.1.4, 1-35 (Dec. 31, 1999).	
As review of the above range exceptions shows, a host of possibilities may trigger a requirement for a launch operator to change its launch vehicle or systems to conform to the latest safety requirements. These possibilities may be divided into two general conditions: where a launch operator is implementing other changes to its launch vehicle, and where the safety considerations are so overriding that a change is reauired.	We have never argued that the grandfathering is unlimited. Air Force has always applied the basic approach we stated earlier "accepting previous decisions unless there is a material change in risk". We applaud Air Force for keeping an open door policy and flexible requirements in this regard. As an example, Air Force has adapted a flexible approach in certain situations like requiring implementation on the 5th vehicle (depending on situation) if the

SNPRM Preamble Section	Comments
Accordingly, although grandfathering may be automatic under the range regime, grandfathering is not unlimited.	economics and safety benefits exist. Because of this, we have the ability to review all options in the design process and to initiate and engage in a productive dialogue with Air Force. Throwing away one such option alone could make or break the economic success of a design.
The issue of grandfathering highlights how the Air Force has successfully dealt with the issue of providing for appropriate public safety while taking into consideration the issues of cost, schedule, and mission assurance. The FAA recognizes that there are parallels that can be drawn between the Air Force's approach to ensuring public safety, including the use of grandfathering, and the FAA's regulatory focus on ensuring public safety without placing undue burden on the launch industry. Since publishing the NPRM, the FAA has considered further the Air Force's approach to grandfathering and how the Air Force has successfully implemented its grandfathering policies to ensure public safety without placing undue burden on the launch industry. Upon the urging of the commenters, the FAA proposes to adopt a similar approach to determining when non-compliance with a particular requirement may be permitted to continue.	Industry applauds FAA decision to consider adapting the Air Force process. Industry urges FAA to continue the approach of providing for appropriate public safety while taking into consideration the issues of cost, schedule, and mission assurance. Industry is particularly concerned with the FAA position as stated on Page 49477 of SNPRM, third column " FAA regulations permit waivers to safety requirements; however, the FAA's focus on the public safety aspects of licensed launches restricts consideration of mission objectives, including cost or schedule considerations, as justification for approval."
3. Applicability of proposed requirements to pre-existing range meets intent certifications	
Under this SNPRM, proposed section 417.1(b) would permit a launch operator not to have to demonstrate an equivalent level of safety to the FAA for certain range "meets intent" determinations if the launch operator was licensed by the FAA and launched from a federal range. In the NPRM the FAA, while proposing not to grandfather noncompliances with the proposed requirements, was silent with respect to how it would treat meets intent certifications. This meant that all launch operators would be required to satisfy all the FAA's proposed launch safety rcquirements once those requirements went into effect. To satisfy a requirement, a launch operator would have to meet the requirement as stated in the FAA's proposed regulations or demonstrate that an altemative approach provided an equivalent lcvel of safety. For existing launch vehicles operating from federal ranges, the federal range safety organizations have granted "meets intent certifications" for substitutes preferred by the launch operators to some of the current range safety requirements. Because the current federal range safety requirements provide the basis for the FAA's proposed requirements, any grant by a federal launch range of a meets intent certification creates the possibility that the launch operator would not necessarily comply in **a** literal Sense with a proposed FAA requirement.	

SNPRM Preamble Section	Comments
The federal ranges have granted meets intent certifications when they found that a launch operator's proposed approach, although literally non-compliant with a requirement, complied with the overall intent of the requirement. To obtain meets intent approval from a federal range, a launch operator's proposed substitute has to maintain an equivalent level of safety despite not meeting the exact requirement. EWR 127-1 at 1-vii (Dec. 31, 1999). For all intents and purposes, a range safety meets intent certification constitutes one form of the FAA's equivalent level of safety. Additionally, a federal range's tailoring of launch safety requirements for specific launch vehicle programs often includes meets intent certifications that apply to a launch vehicle program on a permanent basis.	Meets Intent Certifications are a concept in practice since a long time and largely approved by AF Range Safety through design reviews, test plans and Technical Interchange meetings without formal documentations for all issues. Important issues do get documented. In other words, it exists at both formal and informal levels. As an example, many new versions of Atlas have evolved and have been over the last 10 years with minimal paperwork.
The FAA now proposes through section 417.1(b) that a launch operator would not need to demonstrate an equivalent level of safety to the FAA for satisfying an FAA requirement for a licensed launch from a federal range, if two conditions were met. The first condition would be that the launch operator would have to have a license from the FAA to launch from the federal launch range and the license would have to be in effect as of the effective date of part 417. This is reasonable because, to date, through its baseline assessments, the FAA has relied on the federal range determinations that a particular substitute to a range requirement met the intent of that same requirement. In the context of meets intent certifications, the FAA sees no need to revisit or second-guess that past reliance. Under this SNPRM, the possessor of "meets intent certification" could continue to rely on the range's determination, where a future or different licensee could not. Additionally, even the same licensee would not be able to rely on a pre-existing meets intent certification for any other vehicle or application other than the one for which it was originally granted.	We respectfully disagree with the FAA's proposal to institute complicated conditions to the very simple concept of grandfathering. Even today Range approves meets intent certifications based on what is reasonable and safe. It is not an unlimited relaxation of safety rules nor the process allows indiscriminate use any time. It could be for a launch, for a vehicle, subsystem, component or an operation. It could be oral or written. It could be in a tailoring or it could be in the minutes of a meeting. If a user identifies a need for grandfathering for a component as an example in a new vehicle, Range will review the design and provides a grandfathering, irrespective of the fact a previous grandfathering exists or not, if they are convinced safety is not impacted. In the case of grandfathering, fundamentally there is only one consideration and one condition and it is the significant safety impact. In concept, grandfathering is applicable unless there is a good reason not to grant one. We are also deeply perturbed by FAA use of term "could continue to rely on range's determination". Instead we request FAA consider saying "FAA will rely on Air Force decisions on grandfathering and will accept continuing of this process with no additional reviews or paperwork due to part 417".
Thus, the second condition would be for the launch operator to have a written pre-existing "meets intent certification" for the requirement from the federal launch range from which the launch will take place, or a substitute that the same range approved during tailoring of the range safety requirements for that launch operator. This proposal is consistent with the ranges' own approach to "grandfathering." Under current practice, range grandfathering applies only at one launch site. See Appendix 1C, 1C.1.4.a (permitting grandfathering unless a currently approved component, system or subsystem is to be used in a "new application"). If a launch operator has launched a vehicle from one range and proposes to launch from a different range, the other range will	We are deeply concerned with FAA desire for having written paperwork. Even though an overview of a launch process seems to involve enormous paperwork, we have diligently pursued continuous paperwork reduction in close cooperation with our customers and Air Force. The 'meets intent certification" term seems to imply paperwork for every case. In practice this is not true. Meets intent process is more of an intellectual process that involves deep understanding of the issue and its impact to safety risk. Many issues are disposed off as meets intent in oral discussions. Range insists on paperwork only if it is absolutely needed. If one were to start documenting every case, the cost or paperwork alone would become prohibitive. At any

SNPRM Preamble Section	Comments
review the substitution for acceptability.	time a situation may require discussion of a meets intent certification and development of paper work if deemed necessary. If FAA insists on such conditions requiring paperwork, industry will be forced to divert the limited skilled manpower to such duties steeply reducing our competitiveness in the business. Regarding the statement that a launch from another range requires review is true but the need for written pre existing "meets intent certification" is not true. Typically the other range consults with the first range and the extensive dialogue focusing on key concerns with the Range User leads to what is acceptable. Any regulation pointing to such written paperwork will shift the emphasis to process rather than product and can lead to expensive process dialogue and unnecessary hardware changes.
Review due to a change in launch site is necessary because different conditions at different launch sites may dictate different decisions. If, for example, not performing an environmental test is acceptable at one range, different environments at a different launch site may require that the test be conducted. Environmental factors such as salt, fog and temperature may vary from site to site, as may the potential for extreme environments, such as earthquakes on the west coast and hurricanes on the east coast, thus changing the need for and requirements governing component testing. Similarly, with a change in trajectory profile brought about by launching from a different site, vibrations could occur at different times of flight. The ranges see a need to address and consider these changes and determine whether a substitution acceptable at one launch site is acceptable at another. The FAA agrees with this reasoning and proposes to maintain this practice.	We agree with this process. Our own design process will require all these considerations.
Under this SNPRM, the "meets intent certification" would have to exist as of the effective date of part 417 and the duration of the "meets intent certification" would have to include the licensed launch in question. If a pre-existing meets intent Certification did not apply to a future licensed launch, the launch operator would have to demonstrate an equivalent level of safety to the FAA. For example, the ranges have granted some launch operators meets intent certifications that allowed them to fly without a flight termination system on an upper stage of their launch vehicles. Such range approvals are highly dependent on launch specific conditions and do not necessarily apply outside of certain launch azimuths. The FAA recognizes, however, that even for a meets intent certification granted only for a specific launch there may be a possibility that the reasons that merited grant of a meets intent certification will apply again and the FAA will be able to find an equivalent level of safety. However, just as the ranges reserve the right to	We respectfully disagree with the need for an effective date associated to grandfathering. Reference our earlier discussion. We also disagree with FAA asserting independent rights just like Air Force to make a decision on the grandfathering at the federal ranges. Here we are not questioning legal rights but the practicality and benefit from such a position. We have no issue for exercising that right on non-federal ranges but to do it on a federal range is a duplicative effort causing concern and uncertainty for users. On the other hand users will applaud FAA if it can leave such decisions completely to Air Force who are operating the Range successfully. If such were to be the process there will also be no need for a user relief process. We are also deeply concerned with many aspects of the proposal for a coordinated FAA and Air Force review process and even the need for such on federal range. This is fully discussed in our response to section IVC.

SNPRM Preamble Section	Comments
make that determination for a different set of circumstances, so, too, will the FAA. For future FAA-licensed launches from federal ranges, launch specific decisions such as these will be handled through a coordinated FAA and federal range review process as discussed in section IV.C of this SNPRM.	
4. Pre-existing range waivers and non-compliances that satisfy range grandfathering practices	
Under proposed section 417.1(b)(1) of this SNPRM, the FAA would not apply a requirement of proposed part 417 to a licensed launch if the launch operator is currently licensed by the FAA to launch from a federal range, and if the range has either previously approved a waiver for the requirement or if the noncompliance is in accordance with federal range "grandfathering" practices. Unlike a meets intent certification where a launch operator satisfies a requirement through an alternative that provides an equivalent level of safety, a launch operator at a federal range might not satisfy a current range safety requirement and, therefore, would not satisfy one of the FAA's proposed launch safcty requirements. A federal range may have approved such non-compliances as specific waivers or the non-compliance may have resulted from the launch vehicle program being initiated under an earlier version of the range safety requirements and being subject to Air Force grandfathering policies.	It is important to understand that "grandfathering" is a process as much as a collection of non-compliances, and is not always well documented. There is not always a tailored version of EWR 127-1 or a Meets Intent Certification. Some non-compliances may be in product specifications or test procedures, and some are agreements and are not documented at all. A collection of "all non-compliances" to justify the grandfathered condition would be very extensive and difficult to provide.
In the NPRM the FAA proposed not to grandfather non-compliances, but requested public comments on the issue. Upon consideration of input from industry and the federal range safety organizations, the FAA now believes that it would be appropriate to provide a form of grandfathering that is nearly identical to the Air Force's grandfathering policy. The FAA's version of grandfathering, namely, partially limiting the reach of its requirements, would apply to federal range waivers and other noncompliances that have been grandfathered by a federal range. Since the NPRM was published, the FAA has considered further how grandfathering is implemented in current practice at the federal ranges, including recognizing that there is a degree of safety assurance that can be derived from the demonstrated flight history of an existing vehicle.	Industry applauds FAA for the reconsideration of the grandfathering of non-compliances.
The FAA now proposes to permit, with some exceptions, that a requirement of this part would not apply to a licensed launch from a federal range, if certain conditions were met. These conditions would be the same as those the FAA is proposing for pre-existing meets intent certifications, as discussed above. The first condition would be that the launch operator would have to have a license trom the **FAA** to launch from the federal launch range and the	We disagree with the proposal to impose time restrictions. As we discussed earlier, discussions on noncompliances can start any time, before a license or after the license. The noncompliances are to the Air force range requirements and as such should continue and be acceptable to FAA since FAA has repeatedly stated their intention to accept the Range process.

SNPRM Preamble Section	Comments
license would have to be in cffcct as of thc effective date of proposed part 417. A launch operator who had a launch license on the day that part 417 became effective would satisfy this condition. Although the possessor of the waiver will be able to rely on the range determination, a future or different licensee will not. Additionally, the same licensee would not be ablc to rely on a pre-existing waiver for any vehicle or application other than the one for which it was originally granted.	
The second condition would be that the launch operator, as of the effective date of proposed part 417, had, for that requirement, a written waiver from the federal launch range, or a pre-existing noncompliance that satisfied the federal launch range grandfathering criteria. The FAA intends this provision to encompass noncompliances regardless of the avenue through which they arise. In the first instance, a range may grant a waiver. In the second, a range may have approved a launch vehicle or system under requirements in place some time previously. Although the range requirements may change, a launch operator is not always required to upgrade the launch vehicle or system as discussed above. This provision would apply to both forms of pre-existing non-comnliance.	We disagree with the association of waivers to the effective date of this part. The issuance of waivers can occur before or after a license. We have no problem in providing copies of such approvals to FAA as is done currently. It is however important to let Air Force continue the current process without a concern of contradicting FAA rcquirements. Simply said, we request FAA to let the independent Air force grandfathering process to continue.
The condition that a range approval be in writing would apply to range waivers. See EWR 127-1 at 1-38, Appendix IC, IC.2.4 (describing required range approvals). For a launch vehicle that has been grandfathered, the range maintains a version of the range safety requirements that apply to the vehicle. These are the requirements that are "tailored for that vehicle." For any new safety requirement that the range determines must apply to an existing launch vehicle, the range will update the tailored set of range safety requirements.	
Just as with the FAA's proposed approach to pre-existing meets intent certifications, the FAA would condition not applying a requirement for a licensed launch on an existing non-compliance being already approved for the licensed launch in question. If the range approval of a pre-existing non-compliance did not apply to a future licensed launch, the launch operator would have to meet the requirement as written or demonstrate an equivalent level of safety to the FAA and the Air Force in thc joint relief process discussed in section IV.C of this notice. Because waivers are granted for situations where an equivalent level of safety is not achieved, the FAA considers it even more important than with pre-existing meets intent Certifications that the FAA review the acceptability of a waiver when there are differences from the circumstances that warranted grant of the waiver in the first place. As with thc meets intent certification, the FAA recognizes that the reasons tor a waiver may exist again. However, just as the ranges reserve	Industry disagrees with FAA proposal to involve both FAA and Range Safety in the waiver process. Simply put, industry cannot afford the resources to negotiate with two organizations. Once again, we are deeply disturbed with assertion of FAA the right to approve waivers. We are not disputing the legal rights but the need for exercising it. Over the years we have streamlined the waiver process optimizing the discussion with few experts and approvers. If we now have to negotiate with two organizations across the table, doubling or tripling the audience, it would complicate and extend the process. Industry has limited manpower and it should be noted that the same skilled personnel are involved in all these efforts. We would like to see the continuation of the current process at the federal ranges. Approval should be only by Air Force. Further we would like to see Air force left free to make such decisions without the fear of contradicting FAA regulations. There simnlv is no need for a relief process. Industrv will

SNPRM Preamble Section	Comments
the right to make that determination for a different set of circumstances, so, too, will the FAA.	be happy to continue the current process of providing Range approved waivers to FAA for information. FAA can use such information to develop part 417 to bring it in tune with Range decisions.
5. Limits to grandfathering	
As discussed previously, range grandfathering is not necessarily guaranteed under current practice at the federal ranges. Depending on the criticality of an issue and, given time and opportunity, a federal launch range will strive to bring a launch operator's vehicle and operations into compliance with current safety requirements. Accordingly, the FAA proposes to codify that practice as well in proposed section 417.1(b)(2).	We see no need for codifying the grandfather process. As we have discussed in this response, the current process is well understood and introducing time restrictions and multiple approvals will only complicate the simplicity and elegance of this time proven process. Industry requests FAA to allow Air Force to freely continue the current process unchanged. The process as codified in the SNPRM and described in this preamble does not reflect the existing range grandfathering process in two key areas. (1) Each modification or change in application is currently evaluated in relation to the grandfathered hardware or process that is affected by the change. If the grandfathered hardware or process is minimally affected, particularly in relation to adding risk to the system, the grandfathered status typically remains in place. Under the proposed rule strict compliance, regardless of the change would be mandatory. (2) Grandfathered components are used on new or modified launch vehicles based upon an evaluation of the risk associated with expanded use. Again, per the proposed rule this would not be allowable. Industry requests FAA to allow Air Force to freely continue the current process unchanged.
Like the ranges, even if the launch operator were to satisfy the conditions of proposed section 417.1(b)(1) for a specific requirement of proposed part 417, the FAA proposes that a launch operator must comply with proposed part 417, including by providing a demonstration of an equivalent level of safety, whenever the launch operator makes modifications that affect the launch vehicle's operation or safety characteristics. As with the Air Force's current practice, proposed § 417.1(b)(2) would require a launch operator to upgrade if the FAA or the launch operator determined that a previously unforeseen or newly discovered safety hazard existed that was a source of significant risk to public safety, or if a federal range previously accepted a component, system, or subsystem, but did not identify a noncompliance to an original federal range requirement. In the past, this meant that a launch operator making a major change to its launch vehicle had to upgrade the launch vehicle to satisfy current safety requirements. For example, modifications made to a launch venicie to aiiow the use or strap-on solid rocket boosters where none were	

SNPRM Preamble Section	Comments
originally approved would be considered major modifications that could affect the vehicle's operation and safety characteristics. As a result, many aspects of the original flight termination system would have to be upgraded to comply with the most current requirements. This change would have the effect of codifying the federal launch ranges' current practice.	
The FAA also proposes, as under current practice, that a launch operator bring its launch vehicle or launch into compliance with a requirement when it uses the launch vehicle or a component, system, or subsystem in a new application. A new application may include launching the vehicle from a new launch site or using a safety component on a different stage of the vehicle other than the stage for which it was originally approved.	Such a decision should be left to Air Force alone. Bringing a system to compliance solely for the sake of compliance is not beneficial. This is not current practice at the federal ranges. Arbitrarily redesigning a vehicle component or subsystem due to a change is unnecessary. Each change (including change in launch site) must be evaluated regarding the possible affects on vehicle components, sub-systems, and systems. A qualitative assessment of additional safety risk is the basis for determining whether redesign for full compliance is necessary.
6. Grandfathering of a launch vehicle program at an Air Force range	
The FAA recognizes that the Air Force and licensed launch operators at Air Force ranges often consider a launch vehicle program as a whole grandfathered. The FAA's proposed grandfathering provisions would govern the applicability of individual safety requirements. As is current practice in implementing the Air Force's requirements, the FAA's proposed requirements may be applied to a launch vehicle program such that all aspects of the existing program are grandfathered without the need to upgrade to satisfy the safety requirements of proposed part 417. The Air Force and the FAA are involved in an extensive effort to identify and maintain common launch safety requirements through an interagency group consisting of both Air Force and FAA personnel, called the Common Standards Working Group.[1] The Common Standards Working Group worked to ensure that the FAA's proposed requirements are consistent with the Air Force's grandfathering requirements and can be implemented without duplication of effort. A launch vehicle program that is fully compliant with the Air Force's grandfathering requirements could be fully compliant under the FAA's proposed requirements. This would be possible in the event that all the non-compliances or meets intent certifications for a particular launch vehicle	We appreciate this discussion. We understand the desire of FAA to develop regulations with minimal impacts to the launch vehicle industry. With regard to the grandfathering of existing launch vehicles, we wish to believe that the following is the implementation of part 417. The basic design of ELV products have been completed at this stage. Even though we will be developing several variations over the next decade, the basic design will remain in place. The product design basis is the tailored EWR 127-1. Part 417 or any other new requirements will not be imposed directly or indirectly. Association of any new requirement such as part 417 by direct or indirect implication will lead to a very expensive compliance assessment and response action. Therefore, part 417 when released will not be applicable to EELV or its derivatives until such time a completely new development program similar in magnitude with necessary funding is initiated. This approach should also hold for launch vehicles from Orbital Sciences Corporation and Sea Launch companies. As an industry we are concerned with verbiage such as "A launch vehicle

[1] The Common Standards Working Group consists of, in addition to FAA representatives, Air Force representatives from Air Force Space Command, the Air Force Space and Missile Center, Air Force Safety Center, safety personnel from both the Eastern and Western Ranges, and each of their contractors working in support of this joint effort.

SNPRM Preamble Section	Comments
satisfied the FAA's proposed criteria.	program that is fully compliant with the Air Force's grandfathering requirements could be fully compliant under the FAA's proposed requirements. This would be possible in the event that all the non-compliances or meets intent certifications for a particular launch vehicle satisfied the FAA's proposed criteria." There should be no question that a vehicle approved for flight from a federal range today, can be launched tomorrow with no additional review, no additional data, no additional analyses. For this grandfathering concept to function, the federal range safety process itself must be grandfathered. If a launch operator uses a federal range safety organization, and obtains approval to launch, this should be acceptable to the FAA in light of the FAA baseline assessment process. If the FAA baseline assessment yield deficiencies, industry would hope these deficiencies are resolved agency to agency. If the Office were to add a provision to the rule permitting the Office to accept federal range safety authority determination of launch operator compliance to the range's established safety rules, it would offer the launch operator opportunity to demonstrate an equivalent level of safety mcthodology WITHOUT having to change established compliance hardware processes. This is, in fact, the exact same methodology used currently by the Office today. To be effective, the Office has to accept the federal range safcty authority determination WITHOUT requiring the launch operator to provide additional certifications, documentation, analyses or other duplicative products as a condition to using the methodology. This is, again, the exact same methodology used currently by the Office today. In effect, this proposal would grandfather the range safety process as it exists today. This proposal minimizes the change to the existing industry in terms of requirements definition, requircmcnts verification, analysis , documentation, and the overall federal range process.

SNPRM Preamble Section	Comments
B. Risk Limit for Each Hazard	
1. **Changes to NPRM**	
In proposed section 417.107 of the NPRM, the FAA proposed to aggregate the risks attributable to all mission hazards and set a cap on the total mission risk of all hazards at an expected average casualty of 30×10^{-6}. The FAA received comments in opposition to this proposal from the public, and addressed the concerns with the other members of the Common Standards Working Group. The changes proposed here constitute the results of the consensus reached between the FAA and the U.S. Air Force through the Common Standards Working Group. In summary, the FAA, with the agreement of the U. S. Air Force, now proposes through this rulemaking to adopt the current practice at the 45th Space Wing and to set a cap on the risk presented by each hazard. Because of the differences in underlying assumptions and methodologies for assessing the risk of each hazard, the FAA will not require or consider a limit on the total mission risk created by all the hazards of launch. For any given launch, the risk attributable to the whole mission tends to arise out of one hazard. Accordingly, as a general matter, the FAA still expects the aggregated risk of most launches to remain near an E, of 30×10^{-6}.	The Industry applauds the FAA decision not to aggregate risks attributable to all mission hazards into a 30×10^{-6} casualty expectation cap. However, the Industry proposes that the FAA adopt the EWR 127-1 terminology wherein the risk levels are "guidelines" rather than "caps". This allows for needed flexibility. The Industry notes in this and the following discussion, that the risk levels have not been established by a necessary scientific cost-impact, benefit study ("focused scientific study" in the SNPRM vernacular). This study is fundamental to ensuring the adequate safety of the public while not pre-empting the commercial launch industry. The industry therefore requests that the FAA along with the Federal Ranges immediately undertake such a study.
In the NPRM, the FAA proposed to require that an aggregate of the hazards created by a particular launch not exceed an E, of 30×10^{-6}. NPRM, 65 FR 63921,63981 (proposed section 417.107(b)). This meant that a launch operator would have had to account for all hazards, including, but not limited to, the risks associated with debris, toxic releases and far field blast overpressure. The FAA proposed this limit after consultations with Air Force safety personnel at the 30th and 45th Space Wings. Both wings were receptive to this approach because it supported a theoretical goal of launch risk management, which is to quantify all hazards in a single, normalized risk measure. As noted in the NPRM, the 30th Space Wing found that one hazard typically served as the source of the risk attributable to a mission. NPRM, 65 FR 63921,63936. Conditions that are conducive to driving up the risk associated with one hazard usually make another hazard less significant. Accordingly, representatives of the 30th Space Wing advised that launch availability would not be jeopardized at Vandenberg Air Force Base with a total mission risk cap of 30×10^{-6}. Thus, although the 30th Space Wing advised that it did not, in practice, set a ceiling for aggregate risk at 30×10^{-6}, launches from Vandenberg could meet the standard.	The statement by the representatives from the 30th Space Wing regarding launch availability from Vandenberg Air Force Base can only be based upon existing launch systems. Since risk assessments for future launch systems have not been completed, the 30th Space Wing comments regarding jeopardizing launch availability cannot be supported and may not be true for future launch systems. As such, a total mission risk cap of 30×10^{-6} could jeopardize launch availability for future launch systems, and the FAA should not dismiss this possibility. Therefore, the Industry proposes the risk levels be treated as guidelines until such time as "focused scientific studies" can be conducted to establish acceptable risk levels at each of the Federal Ranges and non-federal launch sites.

SNPRM Preamble Section	Comments
As discussed in the NPRM, the experience of the 45th Space Wing differed. The current practice of the Eastern Range, as described in the NPRM, was to cap two hazards, debris and far field blast overpressure, at an E, of less than or equal to 30×10^{-6}. NPRM, 65 FR 63921,63936. Although the Eastern Range estimates that it accepts a risk at an E, of 233×10^{-6} for the risk attributable to a launch's potential toxic releases, its analysis does not account for a variety of factors that may reduce risk but are difficult to quantify. A review of licensed launches between September 4, 1997, and August 23, 2000, shows that only two out of 39 licensed launches took place with an E, for toxic releases in excess of 30×10^{-6}. Eastem Range Aggregate Risk Study, RTI Int'l (Oct. 2,2001). One occurred on May 4, 1999, with an E, for toxics of 57×10^{-6} for the launch of a Delta III. Thc other occurred on July 10, 1999, with an E, for toxics of 114×10^{-6} for a Delta II launch vehicle. Because all indications pointed to the ability of Western Range launches to continue to satisfy an aggregated risk criteria, and because the Eastem Rangc stated that most of the higher toxic risk numbers applied only to federal government launches, such as the Shuttle and Titan vehicles', both ranges and the FAA agreed to propose the aggregated mission risk cap in the October 2000 NPRM	Prior to establishing any Final Rule, the Industry requests a copy of Eastern Range Aggregate Risk Study, RTI Int'l (Oct. 2, 2001), as well as a briefing from the organizations contributing to the study, to discuss the study and the proposed toxic release Ec limit in more detail. The Industry notes that an evaluation of future launch vehicles has not been made and that future launch vehicles may exceed this requirement. The Industry therefore recommends that the risk levels be treated as guidelines to maintain the needed flexibility.
The FAA received commcnts opposed to aggregating mission risk. Launch operators commenting on the October 2000 NPRM stated they expect the E, values from downrange debris risk alone to be close to or surpass the 30×10^{-6} criteria with flight azimuths entailing African or European overflight. JC Vol. I at 8 (emphasis in original); accord Boeing Cost Impact at 2. The launch operators therefore believed that a single, collcctivc E, at the proposed level would restrict launch availability and cause launch delays, both of which increase launch costs.[2]	Will the FAA ever consider a waiver for any of the individual Ec mission risk caps? If not, then the need for a focused scientific study to re-examine the Ec cap may be necessary if overflight of Europe is ncvcr permitted under the proposed Ec cap. Recommend FAA adopt EWR 127-1 wording and treat risk levels as guidclincs rather than requirements.

[1] The Air Force advises the FAA that it will accommodatc this discrepancy to the common standards through its own grandfathering or waiver process.

[2] The FAA would like to clarify a misunderstanding on the part of the launch operators commenting about how risk is calculated. In the Joint Comments, the launch operators argue that "[t]hc fact is, that the actual public risk can only be realized at one given point in the launch timeline. If a launch vehicle is terminated during up-range flight, there is no threat to the down-range public. Conversely, by the time down-range public is potentially endangered, the up-range public is clear of risk." JC Vol. I at 9. Risk calculations must assess the risk for the entire launch. When making risk calculations to determine whether the public risk criterion is satisfied for a launch, risk is not calculated during the launch but before the flight takes placc and accumulated for all stages of flight. The risk calculation must account for all stages of flight if it is to be used to determine whether flight should be initiated, which is the intended use of the public risk criterion. The mutual exclusivity of failure scenarios has long been recognized and appropriately accounted for in the risk analyses performed at the Air Force ranges. When calculating risk, one of the important variables, namely, the nmhahility nf the launch vehicle's failure (Pf), is proportioned as a failure ratc over each phase of flight so that there is some mahematical accounting for the fact that a launch vehicle can only fail once during flight.

SNPRM Preamble Section	Comments
In light of the concerns raised by launch operators, the FAA again revisited current practice at the ranges through consultations with the Common Standards Working Group. The working group explored in detail the philosophies and limits behind current risk assessment approaches and what was proposed in the NPRM. Air Force current requirements permit different aggregation practices. See EWR 127-1, 1-41, Appendix 1D, 1D.1b ("The overall risk levels may or may not be an additive value that includes risks resulting from debris, toxic and blast overpressure exposures." (Emphasis added))(cited in NPRM, 65 FR at 63936). The current practices at each of the two ranges remain as described in the NPRM. Results of the study conducted in 2001 indicated that there were only a few commercial launches in the past five years that would not have satisfied the aggregation criteria. Having explored a number of alternatives, the FAA now proposes to codify a less restrictive practice of not aggregating risks as proposed by the Common Standards Working Group.	Prior to establishing any Final Rule, the Industry requests a copy of Eastern Range Aggregate Risk Study, RTI Int'l (Oct. 2, 2001), as well as a briefing from the organizations contributing to the study, to discuss the study and the proposed toxic release Ec limit in more detail. Flexibility in the rule needs to be maintained to allow for future launch vehicles and, while the change from an aggregate to an individual risk level is a step in that direction, the individual risk levels need to be evaluated further to determine their future acceptability and suitability.
Although the Common Standards Working Group agrees that a risk assessment that determines the total risk due to all hazards associated with a single launch would be an ideal approach, the group also agrees that there are a number of reasons not to codify such an approach at this time. The Common Standards Working group proposes separate risk criteria for each hazard because it is current practice for the 45th Space Wing, the range from which the majority of commercial launches take place, and because it reflects the disparate approaches to and abilities in modeling the risks of each hazard. Currently, the differences between the hazards create differences in how to measure the risks attributable to each of those hazards. A risk measure accounts for a number of things, including the probability of the undesired event occurring (usually related to the launch vehicle's probability of failure), the characteristics of the hazard, and the characteristics of any exposed populations. At this most general level, both ranges assess risk to account for each of these factors. When it comes to addressing each hazard, however, differences arise. Although the models of the two Air Force ranges tend to account for similar factors, the input to those models differs at each coast.	This and the following narrative suggest the difficulties of determining an appropriate risk level for each hazard, which the industry fully appreciates and recognizes. It is for these reasons and the lack of an accepted "focused scientific study" to establish the risk levels, that the Industry proposes that the risk levels be treated as guidelines as is the current Federal Range practice.
Because the FAA and the Air Force intend for their methodologies to account for the same factors, such as serious injury, population and the like, the Common Standards Working Group had to review the current practice underlying the risk assessment for each hazard. That review demonstrates how difficult it is to normalize among hazards.	See previous comments.

SNPRM Preamble Section	Comments
Population characteristics are, at the most abstract level, treated similarly in that the methodologies and models attempt to describe the location or other attributes of an exposed population in a reasonably conservative manner. But what constitutes a reasonably conservative estimate for one hazard may differ for another hazard, which makes assessing each hazard through a separate inquiry a reasonable exercise. For example, when assessing the risks posed by far field blast overpressure, the conservative approach, in the absence of data detailing true locations, would be to assume all the population is located inside buildings and thus exposed to the danger of flying glass. When assessing the risk posed by a release of toxic substances, on the other hand, the conservative approach would be to assume that at least a portion of the exposed population was outdoors, thus increasing the likelihood of harm from the release. The characteristics of a population relevant to an assessment will also vary depending on the hazard at issue. For example, age will play a role in whether a person is harmed by a toxic release: a toxic exposure that fails to injure a healthy adult may seriously injure an infant or the infirm. Age is a much less important parameter for penetration injuries due to flying glass shards. Accordingly, age characteristics may be necessary for one assessment but not another.	See previous comments.
In analyzing how a particular hazard may cause an injury, the elements of the risk assessments also diverge. Each hazard causes a different kind and degree of serious injury, so that employing separate methodologies and models to address each is reasonable for purposes of analyzing what harms a person. For example, inert debris causes injuries of penetration, blunt trauma or crushing. Explosive debris may cause knockdown and blast injuries, including, for example, "blast lung," gastrointestinal blast injury, damage to the inner ear, and eardrum rupture. Air blast loading caused by far field blast overpressure may break windows and pose a threat of laceration to building occupants or those nearby. Toxic releases may result in damage to the respiratory system, skin, and eyes.	See previous comments.
These different injuries are produced by different causes and the thresholds and measures for serious injury from each hazard will vary. For inert debris, risk assessments tend to account for such characteristics as the mass of the debris, the impact velocity of the debris, debris orientation or the projected area of the debris or a combination of any of these Characteristics. The threat posed by a gaseous toxic release is generally characterized by the concentration levels, described in parts per million, and the duration of exposure. *An* assessment of the far field blast overpressure risk will account for a variety of window characteristics, including window types, fragment	See previous comments.

SNPRM Preamble Section	Comments
sizes, velocities, distances propelled, or impacts per unit area.	
The result of this review is that it is reasonable to perform separate risk assessments and employ separate criteria because of the difficulty in normalizing risk across all the different hazards. The current models for estimating risk used at the Air Force ranges represent the state of the art. Nonetheless, current techniques still cannot aggregate the risk across all hazards in a consistent manner without introducing additional uncertainty. This is due to differences in how the hazards are modeled and the nature and quantification of the serious injuries that result from each hazard.	See previous comments.
2. Alternatives considered	
The Common Standards Working Group explored a number of alternatives before settling on the proposal described above. Those alternatives and their benefits and drawbacks are discussed here. The Common Standards Working Group sought to identify risk assessment procedures that would best protect the general public and reflect current practice without unduly burdening the launch community. In doing so, the working group considered several options both individually and in combination. Chief among the concepts considered were various forms of risk aggregation and risk accumulation. Aggregation requires the risk assessment to combine and limit the total risk associated with the three main hazard categories. Aggregation would ensure that a single risk measure capped the combined risk due to the three main hazard categories. Accumulation combines the risk in the launch area with risk incurred downrange. The group also considered options related to increasing the maximum allowable expected casualty level and imposing different expected casualty limits on new and mature vehicles.	See previous comments.
In addition, the Common Standards Working Group considered a third option that would have required the same risk assessment as the original aggregation and accumulation option outlined in the NPRM. The only difference between the two proposals would have been an increase in the maximum allowable E_c value under this option. Aggregating and accumulating with an increased E_c limit could have prevented the risk assessment from becoming overly conservative by adjusting the acceptable risk criterion. However, the main difficulty with this option would have been that choosing a new expected casualty limit would have been difficult to justify in the absence of historical data on which to base it. This difficulty could be mitigated, however, through a focused scientific study dedicated to logically determining an expected casualty limit. In fact, the Department of Defense's Range Commander's Council has previously conducted a similar study that could be used as a baseline for any future research.	The Industry strongly recommends that the "focused scientific study" be performed to determine the proper limit to set each risk level at and that, in the interim, the rule treat the 30×10^{-6} value as a guideline as done in EWR 127-1. This would ensure that the current E_c limits are neither too relaxed nor too restrictive for a practical commercial space program. If such an analysis has been completed at this time, the Industry requests a briefing on the analysis.

SNPRM Preamble Section	Comments
A fourth option would have required a launch operator to aggregate risks across the three main categories of hazards without accumulating the flight risks incurred in the launch area with those incurred downrange. The result would have been two separate casualty expectation values for each licensed mission. One value would have represented the aggregate risk in the launch area while the other would have represented the risk downrange. In a departure from the current practice as outlined in EWR 127-1, this option would have imposed individual caps on aggregate risk in both areas but would not have imposed a total hazard cap on any single launch. This option may have had less of an impact on launch operators than the NPRM proposal to aggregate, but would have recognized the different methods used to calculate launch area hazards compared to downrange hazards. These differences include variations in the nature of necessary data and the fidelity of the analyses. Such variations reflect the fact that the ranges typically are not concerned with toxic releases or distant focusing of blast overpressure downrange because most or all of the fuel on board the vehicle would have been consumed en route, or lost on reentry due to the break up and dispersion of liquid fuels. Also, data regarding meteorological conditions tends to be unavailable for most downrange far field blast overpressure concerns. As a result, downrange risk would consist almost entirely of the debris risk, whereas launch area risks would also include overpressures and toxic releases. However, the underlying premise of this option is flawed by the fact that separating launch area risks from downrange risks is contrary to pure risk assessment philosophy in that it considers a launch in discrete parts instead of as a single continuous event. For missions involving multiple distinct periods of population overflight, assessing the risk to each region of overflight separately could result in missions with a very high expected casualty even though the mission met the risk criteria for each overflight area. In other words, such an approach would mask the true risk of the whole mission. Another disadvantage is that, like with other proposals in favor of aggregation, it might be difficult to define and calculate a consistent methodology that normalized the effects of each of the hazards. This particular disadvantage arises from the fact that the same expected casualty value may reflect two different things when applied to two different hazard categories. For example, an E, of 30×10^{-6} for toxic releases means something different than 30×10^{-6} for debris because, in most cases, more people would have to be exposed to a toxic release to inflict the same number of casualties as a debris impact. Similarly, the potential for fatalities is much hinher for a launch with an E, of 30×10^{-6} for debris than an E, of 30×10^{-6}	Again, the Industry sympathizes with the FAA's position on this and recommends that the risk levels be treated as guidelines until such time as acceptable risk levels can be established by a "focused scientific study."

SNPRM Preamble Section	Comments
for a toxic release due to the nature of the two different hazards. In other words, with debris hazards, a higher percentage of the casualties are fatalities than with toxic hazards. The final and crucial shortcoming of this option is the difficulty in distinguishing between where the launch area ends and the downrange segment begins. This question might not be critical for a coastal range where the physical boundary between land and sea makes for a logical divider. However, no such physical partition exists for an inland launch site.	
Under a fifth option, a launch operator would have bccn required to aggregate overall risks into a single maximum E, while also capping the maximum allowable risk associated with any one hazard category. Since this option would not have required accumulation, a risk assessmcnt would have required six separate E, calculations for each licensed launch. Launch operators would have needed to calculate an E, value for each of the three hazard categories for the launch area and an E, value for each of the three hazard categories for the downrange portion of the launch resulting in a total of six E, values. This plan would have required each of the six E, values to meet the individual cap while requiring the sum of the six values to meet the total allowable aggregate E, value. The major benefit of this option would have been the ability to recognize the differences between the three main hazard categories while still capping the maximum allowable overall risk level. Unfortunately, not accumulating risks could lead to problems in defining the point in flight where the launch area ends and the downrange segment begins as discussed under the previous option.	See previous comments.
The risk assessment proposed under a sixth option would have been very similar to those outlined in the preceding paragraph in that it would have aggregated overall risks into a single maximum E_c, as well as capping the risk of each hazard separately; however, the cap on the maximum allowable risk associated with any one hazard category would have been on the accumulation of launch area and downrange risks for each hazard. This option would have effectively reduced the number of separate expected casualty values from six to three. This option would not have offered any significant benefit over the other options considered and involves the shortcomings associated with aggregation.	See previous comments.
Under a seventh option, one set of risk criteria would have been developed for new vehicles while a separate set would have been developed for mature vehicles. This option would have allowed the FAA and the launch operators to recognize the role that operational experience with a particular launch system plays in reducing the level of uncertainty involved in calculating the risk associatcd with launching a uarticular vehicle. However. the differences	The Industry agrees with the **FAA's** position on this. Furthermore, the Industry recommends that an appropriate and uniform risk level be ascertained by the aforementioned "focused scientific study."

SNPRM Preamble Section	Comments
between new and mature vehicles are already addressed under current practice by accounting for the demonstrated reliability of different launch vehicles. Currently, there are no accepted definitions for new and mature launch vehicles.	
In summary, the **FAA** proposes to adopt the Common Standards Working Group dctcrmination that, for thc reasons discussed above, risk should be limited by hazard. The **FAA** would limit the risk permitted for debris, far field blast overpressure and toxic release to an E, of 30×10^{-6} for each hazard rather than an E, of 30×10^{-6} for a total of all three hazards as proposed in thc NPRM.	The Industry agrees with this philosophy but would like to see a focused scientific study performed to determine Ec limit values, or be briefed if such a study has been performed by this time. The risk levels are fundamental to and form thc basis of the rule. The Industry feels that, without a "focused scientific study," the rule should maintain the EWR 127-1 terminology and refer to the risk levels as guidelines rather than "limits."

SNPRM Preamble Section	Comments
C. **Debris Thresholds for use in Flight Safety Analysis**	
Based on comments received, the FAA is proposing different thresholds for inert and explosive debris from those proposed in the October NPRM. The October 2000 NPRM would have required that certain probability analyses account for debris with a ballistic coefficient of three or greater. Under 417.107(c) of this SNPRM, the probability analyses would have to account for debris with a kinetic energy of 11 ft-lbs or greater at impact. For explosive debris, such as solid propellant fragments that will explode upon impact, the FAA is changing its proposal from 3.0 psi blast overpressure to blast overpressure of 1.0 psi or greater. The proposed debris thresholds would be applied when demonstrating that a launch satisfies the risk criteria for collective and individual risk of casualties to the public and the criteria for probability of impact for ships and aircraft.	Prior to a Final Rule, the Industry requests a briefing from the Common Standards Working Group to fully understand the proposed changes and the affects these changes would have, if any, on launch availability at the Ranges for current and proposed vehicle configurations. The Industry strongly recommends that these values be treated as guidelines until such timc as the "focused scientific study" proposed by the FAA can be performed to establish them. Codifying the values at this time will result in loss of flexibility. We are concerned that changing to 1.0 psi and counting 100% of the population as casualties is too conservative when in Paragraph IIIC2 the SNPRM states "…the probability of serious injury… is relatively small." The change is not insignificant since the are affected by 1 psi is greater than 4 times the 3 psi area.
In proposing requirements governing the calculations that are part of a launch operator's demonstration of compliance with the public risk criteria, the FAA's intent is to protect against casualties, the proposed definition in section 417.3 of the NPRM of which is "death or serious injury." Not all pieces of debris have the potential to be lethal or cause a person a serious injury. Accordingly, the FAA does not intend that a probability analysis account for all debris, only that which has the potential to cause serious injury or death.	
In proposed sections 417.225 and 417.227 and appendices A and B of the NPRM, the FAA proposed a methodology for conducting a debris risk analysis and analyses for defining hazard areas used to ensure compliance with the individual risk and ship and aircraft impact criteria. See NPRM, 65 FR 64017, 14 CFR 417.225 and 227 and appendixes A and B (proposed). The NPRM proposed that these analyses account for debris with a ballistic coefficient of 3.0 or more, and the analysis would have had to account for a 3.0-psi blast overpressure radius and projected debris effects for all potentially explosive debris. At the time the NPRM was drafted, the FAA believed that these thresholds were consistent with the FAA's definition of casualty, but would not be as conservative as any such thresholds currently used at the federal ranges. However, Air Force members of the Common Standards Working Group raised the concern that any analysis that was limited to these thresholds would not account for significant potential casualties, particularly serious injuries that could result from launch vehicle	This narrative suggests the difficulties of determining an appropriate risk level for each hazard, which the industry fully appreciates and recognizes. It is for these reasons and the lack of an accepted "focused scientific study" to establish the risk levels, that the Industry proposes that the risk levels be treated as guidelines as is the current Federal Range practice.

SNPRM Preamble Section	Comments
debris. The FAA has come to agree with the Air Force's concern and has been working with the Air Force as part of the Common Standards Working Group and have identified appropriate thresholds for debris.	
The Common Standards Working Group is continuing to explore what measures of concern are most appropriate for distinguishing casualty due to launch vehicle accidents. Improvements in modeling may provide room for better measures of what inert or explosive debris might cause a casualty. Recent models suggest that a change in the proposed measure for inert debris from ballistic coefficient to kinetic energy would be appropriate. Overpressure remains the most appropriate casualty measure for explosive debris; however, a change in the pressure level that presents a hazard would be appropriate. The FAA is proposing new thresholds that reflect the latest thresholds for inert and explosive debris that are being considered by the Common Standards Working Group. The FAA specifically requests comments on the debris thresholds proposed in this SNPRM, including any proposals for alternative approaches to estimating casualties.	Prior to a Final Rule, the Industry requests a briefing from the Common Standards Working Group to fully understand the proposed changes and the affects these changes would have, if any, on launch availability at the Ranges for current and proposed vehicle configurations. The Industry realizes the difficulty inherent to establishing debris models and threshold values and strongly desires flexibility in the Rule to accommodate the developing nature of the debris risk modeling described here.
The FAA is proposing that a launch operator's demonstration of compliance with the public risk criteria incorporate one of two approaches when applying the proposed thresholds for inert and explosive debris. The more sophisticated of the two approaches, and the one which would result in the more accurate casualty estimate, would require the use of probabilistic human vulnerability models. These models account for the probability of casualty to any person exposed to the threshold levels or greater for inert and explosive debris. The simpler of the two approaches would count all members of the public exposed to the threshold levels or greater as casualties. The simpler approach would result in a relatively conservative casualty estimation, which may be sufficient for a launch operator, depending on the specifics of a proposed launch. Any probabilistic casualty model used for a launch would have to be approved by the FAA during the licensing process or, if the launch is from a federal range, accepted as part of the FAA's baseline assessment of the federal launch range, as is current practice.	Launch operators cannot afford to develop, utilize, and maintain probabilistic human vulnerability models due to cost, schedule, lack of statistical input data, and lack of experience with such models. Launch operators also cannot continuously afford the expense of subcontracting such work. These models should be the responsibility of the FAA and/or the Federal Ranges. This effort to develop a human vulnerability model would seemingly be best undertaken by the FAA through the Common Standards Working Group as part of the aforementioned "focused scientific study" to determine the appropriate risk levels.
Probabilistic human vulnerability models estimate the likelihood of a casualty as a function of specific parameters that describe the contact with the hazard. The parameters may include kinetic energy, kinetic energy per unit area, overpressure, or toxic concentration. Probabilistic human vulnerability models possess greater fidelity than analysis approaches that employ simple conservative assumptions, such as counting every person exposed to the debris thresholds or greater as a casualty. These models possess greater fidelity because they typically account for the variability in how debris may	Launch operators cannot afford to develop, utilize, and maintain probabilistic human vulnerability models due to cost, schedule, lack of statistical input data, and lack of experience with such models. Launch operators also cannot continuously afford the expense of subcontracting such work. These models should be the responsibility of the FAA and/or the Federal Ranges. Also, see previous comment.

SNPRM Preamble Section	Comments
harm different people such as infants, adults or the elderly to account for age, body weight and physical health. Probabilistic human vulnerability models also account for the variability associated with different injury mechanisms such as blunt trauma, crushing and penetration, as well as the variability of response associated with different parts of the body and body positions, such as whether a person is standing, sitting or supine. These models may account for the variability associated with fragment shape, weight and density and the inherent mathematical uncertainties associated with any probabilistic analysis. A human vulnerability model that reasonably accounts for these factors will produce more accurate casualty estimations than would the use of simple conservative assumptions. Accordingly, the use of a probabilistic human vulnerability model may prove to increase launch availability without jeopardizing public safety.	
It must be noted that there are expenses associated with employing probabilistic human vulnerability models that can be avoided if the specifics of a proposed launch allow the use of a simple conservative approach. These models may possess significant development costs, including the highly specialized and knowledgeable personnel that would be involved. Such models would typically require more detailed input data. For example, in addition to knowing the number of people in a given area, the input to a probabilistic human vulnerability model could require statistics on the physical characteristics of the people and whether they are expected to be in the open or sheltered, and if sheltered, the characteristics of the shelters. **A** launch operator would have to weigh the costs associated with developing and using a probabilistic human vulnerability model against thc potential for increased launch availability.	Launch operators cannot afford to develop, utilize, and maintain probabilistic human vulnerability models due to cost, schedule, lack of statistical input data, and lack of experience with such models. Launch operators also cannot continuously afford the expense of subcontracting such work. These models should be the responsibility of the FAA and/or the Federal Ranges Also, see previous comment.
Some of thc probabilistic human vulnerability models currently used by the Air Force use thc Abbreviated Injury Scale (AIS) of the Association for the Advancement of Automotive Medicine to define casualties, and to distinguish between serious injuries and those of lesser severity. The AIS is an anatomical scoring system that provides a means of ranking the severity of an injury and is widely used by emergency medical personnel. Within the AIS system, injuries are ranked on a scale of 1 to 6, with 1 being a minor injury, *2* moderate, 3 serious, 4 severe, 5 critical, and 6 a non-survivable injury. **A** scaling committee monitors the **AIS** evolution. A review of the current Air Force models found that they count an injury that qualifies as **AIS** Level 3, 4, 5, or 6 as a casualty. The Common Standards Working Group has recommended that any future casualty models used to satisfy Air Force and FAA requirements incorporate AIS Level 3 or greater as the standard tor	What probabilistic human vulnerability models are currently being used by the Air Force or general industry? Again, the Industry wishes to see the probabilistic human vulnerability models discussed here addressed as part of the needed "focused scientific study" and that, until such time as the study is completed, the Rule allow for modeling as well as risk level flexibility.

SNPRM Preamble Section	Comments
distinguishing casualties from injuries of lesser severity. When using the AIS for the purpose of casualty modeling, any injury that, due to its severity, qualifies as AIS Level 3, 4, 5, or 6 would be counted as a casualty. The FAA agrees that the use of AIS Level 3 or greater is appropriate for describing a medical condition sufficiently to allow modeling of casualties for purposes of determining whether a launch satisfies the public risk criteria.	
The FAA recognizes that the 45th Space Wing conducts risk assessment of debris with a kinetic energy of less than 11 ft-lbs for blunt trauma on occasion, but the FAA does not currently plan to codify that practice. The circumstances surrounding that approach currently appear unique to the 45th Space Wing and constitute a response to the crowds of visitors that the Eastern Range must protect for launches. Numerous debris pieces with expected impact kinetic energies of less than 11 ft-lbs may significantly contribute to the risk of a launch when population density is sufficiently high. Also, the criterion of 11 ft-lbs of expected kinetic energy at impact does not ensure protection from serious injuries due to potential penetration wounds. For the time being, however, the FAA will not address this issue. The Common Standards Working Group considered a proposal for a threshold level near 40 ft-lb/in^2 to protect against serious penetration injuries from inert debris impacts. However, the Common Standards Working Group needs more time to evaluate an appropriate debris characteristic to protect against serious penetration injuries. The FAA invites public comments on this subject.	What is the affect, if any, on launch availability for commercial vehicles if kinetic energies less than 11 ft-lbs or threshold levels near 40 ft-lb/in^2 are ever adopted by the FAA? Have launch availability studies been done at the Eastern and Western Ranges for current and proposed launch vehicle configurations? If not, these studies should be done prior to the establishment of any Final Rule. If the studies have been done, the Industry requests a detailed briefing prior to the establishment of any Final Rule. This and the following narrative suggest the difficulty in determining, not only the risk levels, but the modeling methods as well. It is for these reasons, that the Industry wishes the FAA to treat the values as guidelines as is the Federal Ranges' practice.
1. Inert debris	
This SNPRM reflects two changes to the debris measure proposed in the NPRM: a change of the parameter measured to establish the probability of a casualty due to debris from ballistic coefficient to kinetic energy and a possible increase in conservatism, depending on the characteristics of a debris piece, of the threshold from a ballistic coefficient of three to a kinetic energy of 11 ft-lbs. The FAA proposed, throughout the NPRM, using ballistic coefficient as a metric for human vulnerability to estimate risk from inert debris impacts. Comments received from the Air Force and its contractor, ACTA Inc., as part of the Common Standards Working Group highlighted the pitfalls of relying on that metric. These comments have persuaded the FAA that defining hazardous debris as all pieces with a ballistic coefficient (often referred to as beta) of three or greater may fail to adequately protect the public in some cases. The FAA is now changing its proposal to use kinetic energy as the metric for estimating risk to the public from inert debris at a	Prior to a Final Rule, the Industry requests a briefing from the Common Standards Working Group to fully understand the proposed changes and the affects these changes would have, if any, on launch availability at the Ranges for current and proposed vehicle configurations. Also, see previous comments.

SNPRM Preamble Section	Comments
threshold level of 11 ft-lbs.	
Specifying ballistic coefficient as a criterion ignores many important factors. The velocity of a debris piece at impact is an important factor in establishing whether an injury would result, but the terminal velocity of a debris piece at impact can vary significantly depending on the altitude at impact and its ballistic coefficient. Therefore, using ballistic coefficient as a casualty measure for inert debris would not indicate the velocity of impacting debris. Additionally, a debris fragment's ballistic coefficient does not indicate its mass, which is another important factor in establishing injury potential due to impact. A heavy fragment with a large area may be lethal, even though its ballistic coefficient is less than three. Similarly, a light fragment with a small area may be harmless even though its ballistic coefficient is greater than three. For example, consider a 30 pound debris piece, such as a rocket motor case fragment, that behaves like a tumbling plate, with an aerodynamic reference area of 11 square feet and a subsonic drag coefficient of 0.9. This piece has a ballistic coefficient of about three. The terminal velocity for this piece is about 50 feet per second, or 34 miles per hour. This piece would have a kinetic energy of about 1,164 ft-lbs at impact. The NPRM asserts that "a ballistic coefficient of three correlates approximately to a hazardous debris piece possessing 58 ft-lbs of kinetic energy." NPRM, 65 FR 63935. The above example shows, however, that the kinetic energy of debris with a beta of three can be significantly greater than 58 foot-pounds. Accordingly, it is appropriate to consider other factors for determining whether a fragment would produce a casualty.	See previous comments.
Inert launch vehicle debris of concern to the FAA typically threatens humans primarily from blunt trauma due to nearly vertical impact. The debris piece's potential to cause a serious injury upon impact with a person depends primarily on the mass and shape of the debris and the velocity at which it impacts. Because kinetic energy on impact accounts for these three factors, the FAA believes it to be the appropriate metric for gauging the potential for blunt trauma.	See previous comments.
Recently published human vulnerability model results examined by the Common Standards Working Group suggest that for the general public, a kinetic energy of 11 ft-lbs at impact would be a reasonable threshold level for any analysis intending to account for virtually all serious injuries from blunt trauma. When applied as a threshold, 11 ft-lbs would represent the kinetic energy level for debris that could, depending on the specifics of an impact with a person, cause a casualty. As an example, 11 ft-lbs at impact corresnonds to a one-auarter inch thick sauare aluminum date with an edge	What recently published human vulnerability models were examined by the Common Standards Working Group? Also, see previous comments.

SNPRM Preamble Section	Comments
length of about two inches and a weight of about 1.5 ounces impacting at a velocity of approximately 60 mph.	
One must note that not every impact of debris at 11 ft-lbs or greater will necessarily result in a casualty. The probability of casualty due to such an impact is further dependent on a number of other factors specific to the debi and the impact scenario. Probabilistic human vulnerability models are ofter used to account for these other factors, and an analysis that employs these models will produce a more realistic casualty estimate than a deterministic analysis that counts all expected impacts of 11 ft-lbs or greater as casualties	Launch operators cannot afford to develop, utilize, and maintain probabilistic human vulnerability models due to cost, schedule, lack of statistical input data, and lack of experience with such models. Launch operators also cannot continuously afford the expense of subcontracting such work. These models should be the responsibility of the FAA and/or the Federal Ranges. Again, the Industry wishes to see the probabilistic human vulnerability models discussed here addressed as part of the needed "focused scientific study" and that, until such time as the study is completed, the Rule allow for modeling as well as risk level flexibility.
The choice of 11 ft-lbs as a threshold also has practical benefits. The FAA realizes that there is no standard threshold currently in use, and the human vulnerability models used at the federal ranges today may vary depending o the launch vehicle and other factors. The Air Force members of the Commo Standards Working Group have indicated that the models currently used at Air Force ranges satisfy the proposed 11-ft-lb threshold. For example, the debris model used for a Atlas IIAS launch from Cape Canaveral Air Force Station accounts for inert debris with kinetic energy at impact greater than c equal to 7 ft-lbs. A standard threshold would facilitate the development anc application of morc standardized models with associated efficiencies. For these reasons, thc FAA is proposing to use kinetic energy as the metric for estimating the risk of casualties due to blunt trauma from inert debris impac at a threshold level of 11 ft-lbs.	Prior to a Final Rule, the Industry requests a briefing from the Common Standards Working Group to fully understand the proposed changes and the affects these changes would havc, if any, on launch availability at the Ranges for current and proposed launch vehicle configurations. The FAA's stated reasoning for adopting the 11-ft-lb threshold points out the lack of the "focused scientific study" needed to establish the value and, therefore, adequatcly protect the public's safety while economically promoting thc commercial launch industry. Therefore, the Rule should treat this and the other risk levels as guidelines at this time.
This SNPRM would require any risk analysis for blunt trauma due to launcl vehicle debris to account for all potential debris with 11 ft-lbs or greater of kinetic energy at impact. The analysis would apply the relatively sophisticated approach using probabilistic models to assess the probability c casualty due to any debris with kinetic energy at impact of 11 ft-lbs or greater, or it could apply a more simple approach where each expected impa of a person with kinetic energy of 11 ft-lbs or greater would be counted as a casualtv.	See previous comments.
2. Explosive debris	
In sections 417.225 and 417.227 of the October 2000 NPRM, the FAA proposed that a flight safety analysis, a flight hazard area analysis, and a debris risk analvsis had to account for a 3.0-psi blast ovemressure radius or greater and projected debris effects for all potentially explosive debris.	Prior to a Final Rule, the Industry requests a briefing from the Common Standards Working Group to fully understand the proposed changes and the affects these changes would have, if any, on launch availability at the Ranges for current and proposed launch vehicle configurations.

SNPRM Preamble Section	Comments
Explosive debris is debris with the potential to explode upon surface impact. At the time the NPRM was drafted, the FAA believed that this threshold was consistent with the FAA's definition of casualty and would not be more conservative than any such thresholds currently used at the federal ranges. However, comments received from the Air Force and its contractor, ACTA Inc., as part of the Common Standards Working Group indicated that there is a significant potential for casualties at blast pressures below 3.0 psi. The FAA has reviewed this issue with the Common Standards Working Group and now proposes to reduce its threshold for explosive debris to 1.0 psi.	This and the following narrative suggest that the 1.O-psi blast threshold being proposed in the Rule has not been defined by a "focused scientific study." The Rule therefore should regard this and the other risk levels as guidelines as is current Federal Range practice.
Many factors complicate the determination of threshold blast loads from explosive debris that could cause serious injury. These factors include the substantial difference in vulnerability of people in the open and people in buildings, the substantial variability of protection afforded by various building types, the complex nature of blast wave propagation through groups of buildings or hilly terrain, the potential for far field window breakage due to atmospheric focusing of a blast wave under special conditions, and the general lack of data on casualty-blast load relationships for occupants of various building types. In addition to the direct effect that blast overpressure can havc on a person, blast may cause serious injury by breaking glass that may strike a person, by blowing people down, or by collapsing a structure with people in or near it.	See previous.
People in the open are generally less vulnerable to serious injury from blast loads than occupants of typical buildings, particularly if ear damage is discounted as a serious injury. However, persons standing in the open can be seriously injured as a result of being blown-down by Overpressure. Blow-down potential is a function of both blast overpressure and impulse. For an explosive yield of 10,000 pounds TNT, the threshold for serious injury due to blow-down for a **70-ke** person is near 1.4 psi.	See previous.
The FAA recognizes that blast thresholds used currently at federal ranges may vary depending on the analysis being performed and the specifics associated with the people and property being protected. The Octobcr 2000 NPRM's proposal to address the risk associated with 3.0-psi overpressure would have addressed risks only to someone standing outside in the open, a typical assumption for overflight risk analysis. The ranges pointed out that this failed to account for risks to persons in or near a building or other structures. Glass can break at 1.0 psi—or even less—which means that a person in a building is at risk from flying glass shards or other secondary hazards and may be more at risk than a person in the open. The current practice at the ranges accounts for such secondary hazards of explosive	Prior to a Final Rule, the Industry requests a briefing from the Common Standards Working Group to fully understand the proposed changes and the affects these changes would have, if any, on launch availability at the Ranges for current and proposed launch vehicle configurations. Also, see previous comments.

SNPRM Preamble Section	Comments
debris. The Department of Defense Explosive Safety Board (DDESB) approves the siting of buildings that may be subject to approximately 1-psi over pressure level in the event of an accident. Additionally, the Air Force launch ranges use 1.O-psi to dctcrmine a hit to ships for probability of impact calculations. Accordingly, the Common Standards Working Group has reviewed the casualty models and analysis processes used at the Air Force ranges and concluded that the use of 1.0 psi as a threshold for explosive debris would be consistent overall with current practice at those ranges and in the explosive safety community at large.	
Although the **FAA** is proposing overpressure as a threshold parameter, blast effects on humans, especially building occupants, are generally sensitive to the positive phase impulse, as well as the peak overpressure, of a blast load. For example, an explosion with a 50,000-lb TNT equivalent from a launch accident would produce on the order of a 1% probability of serious injury for occupants of typical buildings in the United States located at the 1.O-psi overpressure radius from the source of the blast. However, a more typical explosion (1000-lb TNT equivalent) from a launch accident would produce less than a 0.01% probability of serious injury in the same circumstances. It is important to note that these estimates account for the probability **of** serious injury due to broken glass shards propelled by the blast and assumes the occupants arc equally likely to be anywhere in the building. The difference in the probability of serious injury in the two examples is primarily due to the greatcr impulse of a large explosion compared to one with a lesser yield. However, the probability of serious injury in both cases at the 1.O-psi overprcssure radius is relatively small. Most typical impacts of explosive launch vchicle debris would result in small yields, far below a 50,000 lb TNT equivalent; therefore using a 1.O-psi peak incident Overpressure level as a threshold in a simple explosive overprcssure vulnerability model would, the **FAA** believes, capture any Overpressure which would cause serious injury while at the same time account for the rolc played by the impulse of the blast as well.	The characteristics of typical rocket propellant explosions can be significantly different from explosions of TNT. The Industry recommends that the FAA and Common Standards Working Group initiate a scientific study to determine if the 'TNT equivalence' methodology currently used at Federal Ranges will produce realistic overpressure radii for a variety of common liquid and solid propellant combinations. This assumes that if one corner of the Pentagon is exposed to 1.0 psi we will count all occupants as casualties. Highly unlikely! Also, sec above comments.
When applying the 1.O-psi threshold, any probability analysis would have to account for a 1.O-psi blast overpressure radius for all potentially explosive impacting debris. The analysis may apply a rclatively sophisticated approach that uses probabilistic models to determine casualty due to any blast overpressures of 1.O-psi or greater or apply a simpler approach that counts all people within the 1.O-psi overpressure radius as a casualty. When using the simole approach. the peak incident Overpressure would be computed with the Kingery-Bulmash relationship, without regard to sheltering, reflections, or	It is doubtful that launch operators can afford to develop, utilize, and maintain sophisticated probability models to determine blast overpressure Ec, unless the Ranges already employ or develop such models. Again, these models should be the responsibility of the FAA and/or the Air Force Range Safety organizations, and either organization should provide the model and database(s) to be used..

SNPRM Preamble Section	Comments
atmospheric effects. For persons located in buildings, the peak incident overpressure would be computed at the shortest distance between the building and the blast source. **A** person would be considered a casualty when located anywhere in a building subjected to peak incident overpressure equal to or greater than 1.0 psi.	
The **FAA** anticipates that launch operators launching smaller vehicles, such as Pegasus Taurus, will be able to take advantage of the simple approach. Launch operators conducting launches of larger vehicles would likely resort to use of probabilistic models. The **FAA** requests comments on the proposed debris thresholds and their application, which allows for both simple and sophisticated analysis methods. Because the FAA considers the proposed debris thresholds and their application to be consistent with current practices at the federal ranges it does not anticipate cost impacts, but requests comments on this point.	What are the launch availability affects in using the 1.0 psi blast overpressure requirement with the simpler model approach for the larger vehicle configurations? A briefing on this subject by the Ranges and/or the Common Standards Working Group is requested prior to the establishment of any final rule. Unless developed by the FAA and economic to use, the probabilistic models discussed here will be difficult to develop and expensive to use by each launch operator. Furthermore, the Industry feels that, until such time as the pre-requisite "focused scientific study" is performed to define the risk levels and models, the Rule treat the values and models as guidelines.

FAA SNPRM	Comment
C. FAA and Air Force Process for Relief from Common Launch Safety Requirements	
Launch operators commenting on the October 2000 NPRM expressed concern for problems they believe will arise if both the Air Force and the FAA oversee the safety of launches from Air Force ranges. **JC** Vol. I at 1; Lockheed at **3.** In response, the Air Force and the FAA have established a permanent safety working group to develop **common** launch safety standards and implementation processes. This working group has drafted a process for **coordinated review** of requests for relief from launch safety requirements as well as tailoring of requirements for future programs. This process is outlined in a draft Memorandum of Understanding (MOU) between Air Force Space Command and the FAA Office of the Associate Administrator for Commercial Space Transportation for Resolving Requests for Relief from Common Launch Safety Requirements. The MOU will provide for Air Force and FAA **coordination** on issues that may arise for a specific launch. For day-to-day operations at an Air Force range, the Air Force will remain the primary point of contact for the launch operators. For a licensed launch, when a request for relief from **a common** requirement is made to either agency, **each agency will ensure notification of the other,** and the **two agencies** will **coordinate activities** with the launch operator to ensure an efficient and timely resolution.	The MOU is not sufficiently detailed to allow launch operators to adequately assess the process for satisfying both agencies' oversight requirements. The fact that either agency may disapprove a request for relief amounts to dual regulatory control. The title of the section shows the problem that the launch operators have raised in their comments to the NPRM. The need of "Common" Launch Safety Requirements as defined in the SNPRM and this MOU is what we question. Most of the time "Common" is understood to mean "One" but here it is defined a being two documents with acknowledged differences that must be cross referenced to ensure that both sets of requirements are complied with. There are two agencies to coordinate with, neither of which can act for the other. We believe that one set of rules is all that is needed to ensure the safety of the public. There is no need to "Codify" the range safety requirements that are in existence presently. "Common" regulations or rules as defined in this MOU just mean that there is duplication of requirements that the launch industry must deal with which just increases the problems with getting a timely decision on what is "really" needed to safely launch a vehicle. Through out the Section IV **C** the words "coordinate, coordination, etc. are used to explain how meets intent, waivers and tailoring would have to be handled. Again neither agency has the authority to act on its own, this only leads to confusion on the part of the launch industry and will lead to delays and increased costs because of the duplication of effort needed to satisfy both agencies. Rather than "codifying" common standards, codify that AF procedures apply and make sure the MOU agrees that FAA will participate in any changes to standards. During the recent public meeting, the FAA expressed it's intent to make the rulemaking process transparent to the existing launch industry. This was emphasized during discussion ***of*** the FAA cost assessment related to the proposed rulemaking. In order to make the Part 417 rule transparent to the industry, the existing range safety process at federal ranges must be embraced as an acceptable demonstration of compliance with Part 417 requirements. This should be clearly spelled out in the Air Force to FAA **MOA** and in the final Part 417 rule. This provides the same level of public safety that exists currently. **Also** this implementation is transparent to the launch provider and the vast majority of the existing launch industry.

	This transparency will minimize the overall cost impact. This also provides via the baseline assessment process a vehicle for the FAA to evaluate the performance of the range, and implement changes to the range safety process.
The draft **coordination** process contains provisions to address issues "prior to day of launch," when there is time to **coordinate** and formally document the resolution of an issue before launch, and "day-of-launch" (flight minus 24 hours, often called "real-time") coordination on issues that arise, albeit infrequently, during a launch countdown prior to flight. The Air Force and the FAA will **also jointly participate with launch operators in tailoring** of **common** launch safety requirements during the development of launch vehicle systems to be used for licensed launches from Air Force ranges. The **coordination** process between the Air Force and the FAA will provide for sharing of data to avoid duplication of effort. This **coordination** will allow for **joint resolution** of issues regarding **common** launch safety requirements while ***ensuring* that both agencies' requirements and concerns are addressed** without placing undue burden on launch operators. A copy of the draft Air Force/FAA MOU is available on AST's web site at http://ast.faa.gov.	Any time you have to have two govemment agencies coordinate and approve anything there is no way it will be easier or have a less than positive impact on the launch operations.
The agencies will continue to administer their own waiver processes. In conjunction with the Air Force/FAA Common Standards Working Group, the two agencies addressed whether the FAA could baseline the Air Force's waiver process. The group determined that the FAA, once its requirements became final, could not baseline the Air Force's waiver process. The FAA cannot delegate its responsibility for safety. The FAA has the authority to waive its own requirements. 49 U.S.C. § 70105(c)(3). As the January 2001 Safety MOA between the FAA and the Air Force recognized, neither agency may waive the requirements of the other. Although Chapter 701 allows another agency to assist the FAA, and the FAA plans to continue ***to*** accept the assistance of the Air Force, Chapter 701 does not permit the FAA to delegate its ultimate statutory responsibility for safety to another agency. Accordingly, although the FAA will continue to rely on the Air Force to ensure compliance with the codified standards so long as the baseline assessments show that the Air Force continues to maintain the common standards, the FAA will not be able to accept the Air Force "non-compliance" process through the FAA's baseline assessment. Non-compliances signify a break from the baseline assessment, and they require the appropriate amount of scrutiny from both agencies. Once the common standards are codified, they will be FAA requirements and require FAA approval of a	Two waiver processes do not improve safety and only complicate if not confuse the process. Confusion will only serve to degrade safety. Since all "non-compliances" on FAA licensed launches will require AF approval, baseline the AF process and add FAA review and approval for licensed launches. This establishes one process.

waiver. The FAA's waiver requirements are contained in 14 C.F.R. part 404.	The codification of Air Force requirements is not required and will not only complicate the process but can very well degrade the safety of the launch industry. 14 CFR Part 404? More detailed? Duplicate requirements?
On a practical level, the FAA and the Air Force perceive benefits in the FAA's involvement in the waiver process. The 45th Space Wing has over the course of the past two years invited FAA participation in the range's waiver decisions. Members of the Common Standards Working Group have suggested that coordination between the agencies would be eased by an FAA presence at the ranges, both ***so*** that the FAA has greater familiarity with the different launch programs and so that the FAA will be accessible to range and launch operator personnel. The FAA is considering this option.	
Legal considerations surrounding waivers and equivalent level of safety determinations result, in part, in the protection of the launch operator. For the FAA, approval of a request for relief may create precedent: for example, if one launch operator receives a waiver because it satisfies certain conditions, a similarly situated launch operator might also expect, absent relevant differences, to receive the same waiver. The FAA, whether through its log of decisions required by the Freedom of Information Act, 5 U.S.C. 552(a)(2), or through advisory circulars must allow access to its waiver decisions, and, in so doing, permit others interested in obtaining a decision to grant a request for relief to see how one might be obtained, taking into account proprietary considerations as appropriate. Although the FAA recognizes that the federal ranges make every effort to treat range users equally, the FAA, unlike the federal ranges, is required by the APA to treat similarly situated persons in a similar manner. The Air Force advises that it has generally found that circumstances surrounding every waiver are sufficiently different that a waiver applies only to the program requesting it. The FAA must have a rational basis for distinguishing between different waiver applicants requesting similar waivers. There are implications to this. The requirement for a rational basis creates an incentive for the FAA to carefully consider all possible implementations when developing a requirement so that the agency can identify exceptions where possible during the rulemaking process. Additionally, after a rule goes into effect, the FAA must fully scrutinize any waiver request so that granting one waiver does not result in the grant of so many others that the requirement is effectively nullified. This approach should also ensure fair treatment between launch operators. As discussed below, the FAA and the Air Force have developed plans to coordinate their determinations.	FAA-AF efforts to establish standardized processes for granting waivers must be described more fully in order for industry to support a rulemaking. This whole paragraph seems to say the there will be no waivers since it is too hard for FAA to determine if there may be others the want the same waiver. Again if this shows why the EWR safety requirements should not be codified by FAA. The Ranges have a very good and adequate process to address the real needs for ensuring that a launch is safe. Codify that a single (AF) **process,** not design details. One that requires FAA participation for licensed launches to assure the risk to public safety is still within the requirements.

Although that coordination is a matter internal to the workings of the government, both agencies designed the process to minimize disruption on the launch operator, and a description of it follows.	
An area of particular concem to launch operators appears to be how the agencies would handle a request for relief from launch safety requirements. On January 16, 2001, the Department of the Air Force and the Federal Aviation Administraiion signed a Memorandum of Agreement (MOA) on Safety for Space Transportation and Range Activities. The MOA directs the Air Force and the FAA to work together to achieve common launch safety requirements and to establish a process for communication with respect to interpretations of the common safety requirements as they apply to **U.S.** Government and FAA-licensed launches. The **MOA** further directs the two agencies to coordinate on the resolution of requests for relief from any common launch safety requirement.	The process for resolution of requests for relief remains undefined.
The FAA understands that the complex nature of launch vehicle system safety causes occasional situations where strict compliance with requirements may be difficult, impossible or impractical. In these situations, the launch operator may seek "relief' from the requirement. Relief from a launch safety requirement at an Air Force range typically takes the form of a waiver, or "meets-intent" certification. The Air Force may permit a waiver when the mission objectives of a launch operator cannot otherwise be achieved. The launch operator must obtain a waiver when proposing an activity that does not satisfy an Air Force requirement or when that activity results in greater risk. For the Wing Commander to make an informed decision, personnel responsible for range safety will typically attempt to describe any increase in risk either quantitatively using formal risk analysis techniques or qualitatively based on the specifics of the launch. In some cases the Air Force may waive the public risk criterion. Typically, this would require a significant effort to mitigate risk, such as by increasing reliability of the launch vehicle, and there would have to be a critical national need for the launch. A "meets intent" certification is used when it can be successfully shown that a launch operator's proposed approach, although non-compliant with a requirement in a literal sense, complies with the overall intent of the requirement. To obtain a "meets intent" certification, a launch operator's proposed approach must provide for an "equivalent level of safety." Tailoring of requirements is typically performed when it can be shown that a requirement is not applicable to a given launch vehicle program. Tailoring also typically includes meets intent approvals that apply to a program on a permanent basis. A "meets intent" certification may also be obtained outside of the tailoring process.	

There are many similarities between the way the FAA approaches relief from safety requirements and the Air Force approach. FAA regulations permit waivers to safety requirements; **however, the FAA's focus on the public safety aspects of licensed launches** restricts consideration of mission objectives, including cost or schedule considerations, as justification for approval. The range safety organizations within the Air Force do this as well. Although cost, schedule, and mission assurance are range safety considerations, they are considered secondary to public safety. For government launches, the Air Force Wing Commander may grant a waiver based on national need. Typically, these decisions do not involve FAA-licensed launches. The FAA may grant a waiver if it decides that the waiver is in the public interest and will not jeopardize the public health and safety, safety of property, and national security and foreign policy interests of the United States. 49 U.S.C. § 70105(c)(3). Preferably, a launch operator subject to FAA regulations would demonstrate an equivalent level of safety to obtain relief from an FAA launch safety requirement. The October 2000 NPRM proposed in each part that a launch operator either meet the launch safety requirements as written **or,** for any proposed alternative, demonstrate an "equivalent level of safety." For all intents and purposes, a range safety "meets intent" certification constitutes one form of the FAA's equivalent level of safety. The Common Standards Working Group has agreed **upon** common terminology and definitions of these relief categories to minimize the overall impact on launch operators while maintaining the current flexibility.	This statement says that the AF does not focus on public safety, which is wrong. The reason for range safety existence is for public safety. The AF and launch contractors work as a team to ensure the public is protected from any processing or launch failures. We would like to see the FAA incorporate themselves into this team and not set up another competing process no matter how "common" it is proposed to be. The FAA's proposed use of waivers is not clear. Waivers are permitted by CSLA and FAA regulations, 14 C.F.R. § 404.5(b). However, the SNPRM preamble indicates that the FAA will be reluctant ever to grant a waiver. The FAA states: "Preferably, a launch operator subject to FAA regulations would demonstrate an equivalent level of safety to obtain relief. . . ." SNPRM at p. 49477. The FAA further states that its "focus on the public safety aspects of licensed launches restricts consideration of mission objectives, including cost or schedule considerations, as justification for approval." ***Id.*** A single process (AF) that requires FAA participation and approval for licensed launches will serve this function. Launch operators accept the concept that FAA approval will be necessary for licensed launches and early coordination of all changes affecting public safety must be well understood and coordinated before launch.
Commenting launch operators expressed concern that the process of clearly and convincingly demonstrating to the FAA that an alternative approach provides an equivalent level of safety would prove unduly burdensome, and in some instances, unworkable, compared to the tailoring process with the federal ranges. JC Vol. I at 5. The FAA does not foresee an increase in the level of effort on the part of a launch operator to obtain an equivalent level of safety determination and believes that industry's concerns in this area have been addressed. The Common Standards Working Group does not anticipate that FAA involvement will increase the difficulty or lengthen the tailoring process. The FAA has reviewed a sampling of meets intent certifications and tailoring granted by federal ranges in the past and finds that they would satisfy the FAA equivalent level of safety criterion. In addition, the FAA has demonstrated on numerous occasions its willingness and ability, within the context of its regulations and processes, to be flexible in the implementation of its requirements. The FAA has taken into account the unique aspects of the program of each current licensee as the FAA	It seems that the FAA has changed their thought process'stated in the NPRM and quoted below, that, for example the Flight Safety System must be designed exactly as required in the NPRM or it will require a greater level of safety and the vehicle be launched from a remote location. Where is this change documented in the SNPRMY Also where is the response to industry comments , also quoted below, located? **§ 111. Discussion of Proposed Licensing and Safety Regulations for launch** **F. Flight Safety System** **Page 63940, second column, paragraph 7. Alternate Flight Safety Systems, first paragraph.** A flight safety system would be required to satisfy all the functional, design, and test requirements **of** proposed subpart D of part 417 unless the FAA approved otherwise through

worked with that licensee to achieve its goals while meeting everyone's mutual public safety responsibilities. For launches from a non-federal launch site, the October 2000 NPRM proposes that the FAA and a launch license applicant use the license application process to identify requirements that are not applicable and to ensure that any alternative approach that provides an equivalent level of safety becomes part of the terms of the license. For future launch vehicle programs that will conduct licensed launches at a federal range, the launch operators will continue to follow the Air Force process with participation from the FAA. The FAA and the Air Force will work in a coordinated effort with the launch operator to tailor the common launch safety requirements and make equivalent level of safety decisions for the launch operator's systems.	the licensing process. The FAA would approve the use of a flight safety system that did not satisfy all of proposed subpart D if a launch operator demonstrated that the proposed launch achieved a level of safety equivalent to satisfying all the requirements of proposed subpart B and proposed subpart D. In such cases, a launch operator would have to demonstrate that the launch presented significantly less risk than would otherwise be rewired, both in terms of E_c and any other significant factors underlying a risk determination. The reduced level of public risk would have to correspond to the ~~reduced capabilities of the~~ proposed flight safety System. To achieve the reduced level of public risk, the launch would typically have to take place from a remote launch site with an absence of population and any overflight of a populated area taking dace only in the latter stages of flight. The proposed alternate flight safety system would have to perform its intended functions, however they might differ from the requirements of subpart D, with a reliability comparable to that required by subpart D. Joint Industry Comment to NPRM An alternate flight safety system does not necessarily mean that it is less safe or has "reduced capabilities" then the one previously approved, just different. An alternate flight safety system should be held to the same safety standard as a traditional system. Existing flight safety systems that are currently approved by federal ranges have proven their level of safety. These systems meet the intent of this NPRM and should be accepted as is. If an alternate system achieves a level of safety that is equivalent then why does it need to demonstrate that the launch presented significantly less risk than would otherwise be required, both in terms of E, and any other significant factors underlying a risk determination'?

MEMORANDUM OF UNDERSTANDING
BETWEEN
AIR FORCE SPACE COMMAND
AND
FEDERAL AVIATION ADMINISTRATION
OFFICE OF THE ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE TRANSPORTATION
FOR
RESOLVING REQUESTS FOR
RELIEF FROM COMMON LAUNCH SAFETY REQUIREMENTS

U.S. AIR FORCE

FEDERAL AVIATION ADMINISTRATION

AIR FORCE SPACE COMMAND

MOU Paragraph	Suggested Chanpe or Comment
I. PURPOSE	
This Memorandum of Understanding (MOU) explains the roles and responsibilities of Air Force Space Command (AFSPC) and the Federal Aviation Administration (FAA) Office of the Associate Administrator for Commercial Space Transportation in resolving requests from launch operators for relief from AFSPC and FAA common launch safety requirements.	The Draft MOU does nothing to alleviate the concerns expressed above. Instead they just more clearly express that the FAA and AFSPC must **both** be involved in deciding how to handle any common safety requirement. This does nothing to reduce the impact of the rule making on the launch industry.
II. SCOPE	
This MOU applies to the implementation of AFSPC and FAA common launch safety requirements for Government and FAA-licensed launches. This MOU contains provisions for timely and efficient coordination between the two agencies as they exercise their roles and responsibilities for overseeing safety of commercial space launch and reentry, without altering or otherwise modifying the roles and responsibilities delineated by statute or national policy applicable to the FAA or AFSPC.	"Common launch safety requirements" means "requirements that are shared by the FAA and AFSPC . . . . These requirements will be codified in FAA regulations . . . ." Are operators launching out of non-federal ranges subject to "common launch safety requirements" as such? Does the Air Force have any authority to regulate commercial launches from non-federal ranges? CSLA Section 70116(a) provides for ***consultation*** with the Air Force but does not afford the Air Force separate regulatory oversight. There are many occasions where an "agreement" which is not always documented or may be documented in test plans. These generally do not "affect safety", but are changes to the requirements of the EWR (Safety Requirements). This document needs to address these issues and allow less rigorous approval of these "non-compliances". (Examples include: Extension of "service life" after a launch is delayed, Modified Qualification test procedures following restart **of** production line, changes in test procedures or numbers for retest.)
III. AUTHORITY	
This MOU is consistent with the Memorandum of Agreement (MOA) Between the Department of the Air Force and the Federal Aviation Administration on Safety for Space Transportation and Range Activities, January 16, 2001. Section VI, Paragraph C of the MOA directs the Air Force and the FAA to work together to achieve common launch safety requirements and to "develop, maintain, and implement a process for communication with respect to interpretations of the common safety requirements as they apply to government and FAA-licensed launches." The MOA directs that this process be utilized in connection with "requests from any launch operator for a waiver, deviation, or meets intent certification," or, in other words, for relief from any common launch safety requirement. For FAA-licensed launches from AFSPC ranges, the MOA directs that the Air Force and FAA coordinate to resolve any relief issues related to the common launch safety requirements.	

MOU Paragraph	Suggested Chanpe or Comment
IV. OBJECTIVES	
This MOU is intended to:	
A. Provide a framework for AFSPC and FAA implementation of the agreements made in the January 2001 MOA regarding coordination on issues involving relief from AFSPC and FAA common launch safety requirements.	
B. Minimize the regulatory burden on the U.S. commercial space sector by clearly delineating federal agency requirements and responsibilities with regard to interagency coordination on issues involving relief from the common launch safety requirements to preclude unnecessary overlap and duplication.	Whether this MOU achieves a clear delineation of the respective responsibilities is questionable. The only way to minimize thc regulatory burden is **to** have one agency not two, and have a single "process".
C. Define an interagency process for coordination on tailoring of the common launch safety requirements during the development of a launch vehicle.	
D. Define an interagency process for resolving requests for relief from common launch safety requirements that:	Therefore make a single system that involves the FAA for licensed launches.
i. Builds upon and enhances current AFSPC and FAA processes for resolving relief issues.	
ii. Provides for sharing of data to avoid duplication of effort and allows for joint resolution of issues while ensuring both agencies' requirements and concerns are addressed.	
iii. For FAA-licensed launches from AFSPC ranges, provides for interagency coordination on routine requests for relief prior to day of launch and time critical requests for relief on the day of launch.	
iv. For FAA-licensed launches from non-AFSPC ranges and government launches, provides for sharing of data on relief issues related to AFSPC and FAA common launch safetv reouirements.	See comment at MOU Article II, Scope, above
V. DEFINITIONS	
A. Equivalent level of safety means an approximately equal level of safety. An equivalent level of safety may involve a change to thc level of expected risk that is not statistically or mathematically significant as determined by qualitative or quantitative risk analysis. Equivalent level of safety determinations made by AFSPC ranges have been referred to as "meets intent certifications."	We propose instead that "equivalent level of safety" be defined as follows: Equivalent level of safety means "substantially the same level of safety." ~~an "approximately equal" level of safety. An equivalent level of safety may involve a change to the level of expected risk that is not statistically or mathematically significant as determined by qualitative or quantitative risk analysis.~~ For Delta II the "meets intent certifications are called "Safety Equivalency Reports (SERs)".

MOU Paragraph	Suggested Change or Comment
	The FAA's proposed definition is too constraining. If the "change to the level of expected risk" for any alternate analysis or method cannot be "mathematically significant," then can the risk be at all different'? "Mathematical" is defined as "rigorously precise." The Federal Aviation Regulations, while using the language "equivalent level of safety" in many instances, do not define the phrase. Nor do the FAA's launch site licensing regulations.
B. Common launch safety requirements means requirements that are shared by the FAA and AFSPC and that protect the public from hazards associated with space launch. These requirements will be codified in FAA regulations, Code of Federal Regulations 14 C.F.R. Ch. III, through FAA rulemaking. At AFSPC ranges, the common launch safety requirements will be implemented in AFSPC range safety documents.	Again two sets of regulations to govern one activity. This is duplication of effort and will cost the launch industry to comply with these two separate regulations. It is also wasting taxpayer money to "codify" range safety requirements when there is no increase in safety by doing so. Does the last sentence mean that that at federal ranges EWR applies and FAA rules do not apply?
C. Launch operator means a person or entity who conducts or proposes to conduct the launch of a launch vehicle. AFSPC often refers to a launch operator as one of its range users.	
D. Tailoring means the process used at AFSPC ranges beginning at program introduction where AFSPC (range safety organizations) and a range user (launch operator) review each range safety requirement and jointly document whether or not the requirement is applicable to the range user and if it is applicable, whether or not the range user will meet the requirement as written or achieve an equivalent level of safety through an acceptable alternative. The FAA and a launch operator undergo a similar process through licensing for launches from non-federal launch sites.	We understand the AF Tailoring process very well. **Is** this the process that FAA will use for Federal Ranges? **If** so then so state in this MOU. If not then where is the FAA tailoring process defined? It should be defined in this MOU.
E. Waiver means a decision that allows a launch operator to continue with a launch, including launch processing, even though the launch operator does not satisfy a spccific safety requirement and is not able to demonstrate an equivalent level of safety. **A** waiver applies where a failure to satisfy a safety requirement involves a statistically or mathematically significant increase in expccted risk as determined through quantitative or qualitative risk analysis, and the activity may or may not exceed the public risk criteria.	
VI. GENERAL	
The Air Force and FAA established Common Standards Working Group (CSWG) **is** responsible for developing and ensuring the consistency of the common launch safety requirements that will be contained in FAA regulations and AFSPC range safety requirements. The AFSPC range safety documents will include the common launch safety requirements; however, they will also address a broader range of issues. Once the **AFSPC** and **FAA** common launch safety requirements are final, the AFSPC ranges, in day-to-day practice, will only need	

MOU Paragraph	Suggested Change or Comment
to work from AFSPC range safety documents. The FAA baseline safety assessments of each AFSPC range will cross-reference the common launch safety requirements between the FAA regulations and AFSPC requirements. The complexity of launch vehicle systems and operations causes situations where strict compliance with specific requirements may be difficult or impossible. In these situations, a launch operator may seek relief from a requirement. The FAA and AFSPC may approve relief from a common launch safety requirement by finding an equivalent level of safety or granting a waiver based on criteria in AFSPC range safety documents and 14 CFR Ch. III and following the coordination process outlined in this MOU. The CSWG will periodically review the implementation of this MOU as required and mutually agreed to and propose any future updates to enhance AFSPC and FAA Coordination on relief issues. At a minimum, this MOU will be reviewed every four years, in conjunction with review of the Januarv 2001 MOA.	Don't cross-reference. If AF is **all** inclusive, use these as baseline and "tailor out" where the FAA does not apply. This way there is one set of consistent references. Again neither agency can act on its own. They must send the waiver through their individual processes which will only add cost, impact schedule, increase complexity and adc confusion to the waiver process. Again if you make it ONE process that goes both ways when necessary it would help. What is 14 CFR Ch III? Is this different from common standards?
VII. FAA-LICENSED LAUNCHES FROM AFSPC RANGES	
A. AFSPC will continue to act as the primary interface with the launch operator for requests for relief from safety requirements. The Launch Wing Commander, who is the Launch Decision Authority, determines whether a launch attempt may proceed. **Neither agency may overrule the other's denial of a request for relief from a common launch safetv requirement.**	Since the FAA requirements are law and are much harder to tailor or waive (**as** indicated in the Section **IV** C paragraph about the legal complications of waivering the FAA regulation) there will be negative impacts from having FAA involved in the waiver process.
B. The FAA and AFSPC will jointly stress to the launch operator that the launch operator's first course of action when seeking relief from a common launch safety requirement is to develop an alternative that provides an equivalent level of safety. AFSPC and FAA staff will work **jointly** with the launch operator's staff as early as possible to identify the best technical approach.	Another reason for a single (AF) Process and a duplication of effort that does not help safety.
C. The FAA and AFSPC will notify each other of all requests for relief. Notification of requests may be accomplished by telephone, fax, or e-mail to a designated representative.	Again this is an extra step and extra process that is not present now and will not add to the safety of the public, but could delay approvals and possibly a launch if the notification does not take place in a timely manner.
D. Both agencies will share copies of all formal documentation used by a launch operator to request relief and any supporting documents. Proprietary data will be properly protected.	
E. For a request for relief for a scheduled launch, the FAA and AFSPC will first estimate whether there is sufficient time before the launch to resolve the request. The agencies will immediately inform the launch operator if AFSPC or the FAA believes that there may not be sufficient time to resolve the issue before the launch.	
F. The FAA will identify any licensing activity that may be required with	This statement is not a "joint" item, it should be in the FAA requirements if nccessary.

MOU Paragraph	Suggested Chanpe or Comment
respect to a request for relief, such as changes to a license application that may be in process or preparation of a license modification for an existing license.	Request for relief should not require a change to license, only become an addition to the request.
G. The FAA and AFSPC will jointly review each request with the requesting launch operator. This review may be accomplished via teleconferences, e-mail correspondence, or face-to-face meetings.	
H. Both agencies will notify each other of all review activities. **A** review activity will not proceed in the absence of one agency without the consent of that agency. The agencies will have an initial government-only face-to-face meeting or telephone conference on a relief issue early in the process to determine whether there are any areas of conflict and to resolve a conflict, if one exists.	Industry would hope that "unavailability to participate" would not result in a launch delay.
I. For each review activity, both agencies will share copies of any launch operator presentation materials and the results of the review activity.	
J. After the final clear to launch poll (FCLP) the AFSPC Launch Decision Authority or designee will dctermine, using his or her best judgment, whether the common launch safety requirements remain satisfied. The AFSPC Launch Decision Authority or designee may allow a launch to proceed in the event of a noncompliance with an AFSPC or a launch operator requirement only if he or she determines, using his or her best judgment, that the noncompliance does not violate a common launch safety requirement.	
K. The FAA and AFSPC will share copies of all documents used by either agency to resolve a request for relief from a common launch safety requirement. The documentation process will incorporate the following:	
i. The FAA will complctc an attachment (see Attachment A) that both agencies will include as part of their approval documents. The attachment will:	
a) Identify each affected common launch safety requirement and provide references to the applicable AFSPC and FAA safety requirements documents;	
b) Identify the extent of interagency coordination in reviewing the request for relief and identify the AFSPC, FAA, and launch operator points of contact;	
c) State the FAA's position on the resolution of the request for relief and any related issues including all technical justification for the FAA's position;	
d) State the extent and applicability of any relief that has been approved for FAA-licensed launches (such as, one time, limited, or permanent); and	
e) Identify any follow-on FAA licensing activities for future launches.	
ii. For any resolution made less than 24 hours prior to a launch attempt or launch, the FAA and AFSPC will jointly document the resolution in the form of a post-launch attempt or post launch report. The report will identify all range and launch vehicle systems involved and the day of launch conditions that led to the request for relief as well as all technical justification for the resolution	

MOU Paragraph	Suggested Change or Comment
VIII. FAA-LICENSEDLAUNCHES FROM NON-AFSPC RANGES AND GOVERNMENT LAUNCHES	
A. Government launches of dual use launch vehicles. For government launches of launch vehicles used for both government and FAA-licensed launches, AFSPC will invite the FAA to participate in AFSPC's review of requests for relief from common launch safety requirements. The FAA recognizes that it does not have jurisdiction over government launches, which may take place from federal or non-federal launch sites. AFSPC recognizes that an FAA-licensed launch site operator may only operate within the scope of its license for any launch from that site. The two agencies will coordinate for informational purposes in accordance with the following:	
i. AFSPC, the FAA, and the launch operator will identify any issues that may have an effect on FAA-licensed launches. In accordance with the January **2001** MOA, the two agencies will communicate with respect to interpretations of the common launch safety requirements and will share, to the greatest extent possible, launch vehicle and launch support equipment safety and performance data common to licensed and non-licensed launches for the purposes of maintaining an accurate baseline concerning a dual use system's compliance with the common launch safety requirements.	
ii. AFSPC will provide the FAA copies of the AFSPC resolution documentation for relief from a common launch safety requirement. The FAA will provide AFSPC and the launch operator a completed copy of attachment A of this MOU depending on the level of involvement of the FAA in the review process and whether any issues are identified that would have an effect on any potential FAA-licensed launch.	
B. Government-only launch vehicles. For launch vehicles and launch support equipment used only for government launches from AFSPC ranges, the FAA will be invited to participate in reviewing requests for relief from common launch safety requirements at the discretion of AFSPC. For government launches from FAA licensed launch sites, the FAA may participate upon the FAA's request.	
C. FAA-licensed launches from Non-AFSPC Ranges. The FAA will invite AFSPC to participate in the FAA's review of requests for relief from common launch safety requirements for a launch from a non-federal launch site where the proposed action might impact Department of Defense missions. The two agencies will coordinate in accordance with the following:	What does "participate" mean'? The FAA has authority under the CSLA to coordinate with the Air Force on national security matters. Does the Air Force have separate authority t oversee commercial launches from non-federal launch sites?
i. AFSPC and the FAA will share with each other their respective interpretations of the common requirements and will share launch vehicle and launch support equipment safety and performance data common *to* licensed and non-licensed	

MOU Paragraph	Suggested Change or Comment
vehicle safety and performance.	
ii. The FAA will provide AFSPC copies of the resolution documentation for relief from the common launch safety requirements. The documentation will carry attachment A of this MOU.	
IX. TAILORING	
A. AFSPC (range safety organizations) and the FAA will Jointly participate in all tailoring of the common launch safety requirements for launch vehicles used	

Lance Lord, General, USAF
Commander
Air Force Space Command

Patricia Grace Smith
Associate Administrator
for Commercial Space Transportation

(Attachment **A)**

RELIEF FROM AFSPC/FAA COMMON LAUNCH SAFETY REQUIREMENT	
Subject:	Date:
Summary:	
AFSPC Requirement Reference(s):	FAA Requirement Reference(s):
Technical Points of Contact: AFSPC: FAA: Launch Operator:	
FAA Position: Extent and applicability of any relief for FAA-licensed launch: (such as, one time, limited, or permanent):	
FAA Licensing Activity: Status:	
Manager, Licensing and Safety Division FAA Office of the Associate Administrator for Commercial Space Transportation	

FAA SNPRM Preamble	Comment
Part 417, LAUNCH SAFETY	
This SNPRM would revise the table of contents for proposed subpart **C** of part 417 to reflect the modifications that this SNPRM makes to that subpart.	No comment

FAA SNPRM Preamble	Comment
Subpart A, General	
This SNPRM modifies § 417.1 of the October 2000 NPRM to include provisions for existing launch vehicle systems to which some of the safety requirements proposed in part 417 would not apply. These changes represent a form of grandfathering as discussed in section III.A of this SNPRM.	
The title of § 417.1 has been changed to "scope and applicability." The NPRM's § 417.1, which provides the scope of part 417, is now paragraph § 417.1(a), General. This paragraph contains the same language as the October 2000 NPRM except for the second, fourth and fifth sentences. The second sentence now reads: "The safety requirements contained in this part apply to all licensed launches of expendable launch vehicles unless paragraph (b) of this section applies." The fourth and fifth sentences now read: "For a licensed launch from a federal launch range, the administrative requirements contained in this part do not apply if the FAA, through its baseline assessment of the range, finds that the range satisfies the requirements of part 417. For a licensed launch from a federal range where the range does not satisfy one or more or the requirements of part 417, the FAA will identify the administrative requirements that apply to the launch during the licensing process." The new proposed fourth and fifth sentences provide clarification for whether the proposed administrative requirements in part 417 would apply for a proposed launch from a fcdcral rangc. As indicated in the new proposed second sentence, thc SNPRM proposes to add paragraph § 417.1(b), which would contain provisions for determining whether a specific requirement would apply to a licensed launch operator at a federal range. Unless one or more of the conditions of paragraph (b)(2) of proposed section 417.1 occurs, if a launch opcrator has a license from thc FAA to launch from a federal launch range as of thc effective date of part 417 and, for a specific requirement of this part and launch, if the launch operator employs an alternative to the requirement for which the federal range has granted a written meets intent certification as of the effective date of part 417, the launch operator would not be required to demonstrate to the FAA that its alternative provided an equivalent level of safety. If the launch operator had, as of the effective date of part 417, a written waiver from the federal launch range or a pre-existing noncompliance that satisfied the federal launch range's grandfathering criteria, the requirement would not be applicable to the launch. A discussion on the issue of grandfathering and the FAA's reasons for proposing these changes from the October 2000 NPRM is provided in paragraph III.A of this SNPRM.	
Paragraph § 417.1(b)(2) wouid contain criteria for when a requirement wouid	

FAA SNPRM Preamble	Comment
be applicable to a launch operator even if the launch operator satisfied the provisions of § 4 17.1(b)(1). Even if a launch operator satisfied paragraph (b)(1) for a specific requirement of part 417, the launch operator would be required to bring its launch and launch vehicle, components, systems, and subsystems into compliance with the requirement, including any demonstration of equivalent level of safety, whenever one or more of the following conditions occurred: (i) the launch operator makes modifications that affect the launch vehicle's operation or safety characteristics; (ii) the launch operator uses the launch vehicle, component, system, or subsystem in a new application; (iii) the FAA or the launch operator determines that a previously unforeseen or newly discovered safety hazard exists that is a source of significant risk to public safety; or (iv) the federal range previously accepted a component, system, or subsystem, but, at that time, a noncompliance to an original federal range requirement was not identified. For all intents and purposes these are the same criteria currently used by the Air Force for determining when range safcty grandfathering expires.	
The Common Standards Working Group has developed a number of definitions to help ensure common interpretation and implementation of launch safety requirements. For any term with a common definition that the FAA uses in its launch safety regulations, the FAA proposes to include the common definition in § 417.3. The SNPRM proposes to replace or insert the definitions into § 417.3 in alphabetical order as follows:	Suggest adding the definition of 'Grandfathering' to this section.
Equivalent level of safety would mcan an "approximatcly cqual" lcvel of safety. "Approximately equal" has mathcmatical mcaning, and is clarified by the fact that an equivalent level of safety dctcrmination could involve a change to the level of expected risk that was not statistically or mathematically significant as determined by qualitative or quantitative risk analysis. Explosive debris would mean solid propellant fragments or other pieces of a launch vehicle or payload that result from break up of the launch vehicle during flight and that explode upon impact with the Earth's surface and cause overpressure.	
Mccts intcnt ccrtification would mean a decision by a federal launch range to accept a substitute means of satisfying a safety requirement where the substitute provides an cquivalent level of safety to that of thc original rcquircmcnt.	
Normal flight would mean the flight of a properly performing launch vehicle whose real-time instantaneous impact point does not deviate from the	

FAA SNPRM Preamble	Comment
nominal instantaneous impact point by more than the sum of the wind effects and the three-sigma guidance and performance deviations in the uprange, downrange, left-crossrange, or right-crossrange directions.	
Normal trajectory would mean a trajectory that describes normal flight.	
Risk would mean a measure that accounts for both the probability of occurrence and the consequence of a hazard to persons or property.	
Although the FAA proposed to include its definition of "serious injury" in proposed part 417, it is withdrawing that definition because it is better suited to the reporting requirements for which is was originally intended. See 14 C.F.R. § 415.41(b) (reporting requirements for an accident investigation plan). For purposes of determining whether exposure to a given quantity of a hazard could create a scrious injury, the proposed definition was not adequate, and the FAA does intend to employ it in proposed part 417. The reporting definition was not adequate because it does not provide the information necessary for realistic modeling of casualties and is not always consistent with the models currently used to estimate potential casualties due to a proposed launch. The FAA notes that the Abbreviated Injury Scale discussed earlier in this SNPRM provides a useful means of distinguishing between serious injuries and those of lesser severity.	
Waiver would mean a decision that allows a launch operator to continue with a launch despite not satisfying a specific safety requirement where the launch operator is not able to demonstrate an equivalent level of safety. A waiver may apply where a failure to satisfy a safety requirement involves a statistically or mathematically significant increase in expected risk as determined through quantitative or qualitative risk analysis, and where the activity may or may not exceed the public risk criteria.	

FAA SNPRM	Comment
Part 417, Subpart B, Launch Safety Requirements	
§ 417.107 Flight safety.	
This SNPRM modifies the **FAA's** proposed public risk criteria in paragraph § 417.107(b) of the original NPRM to reflect understandings reached in the Common Standards Working Group in consideration of public comments. The primary change being proposed in this SNPKM in the area of risk is that the **FAA** proposes to limit the risk attributable to each hazard rather than to limit an aggregate of the risk for all hazards as was proposed in the original NPRM. **A** detailed discussion on the modified public risk criteria proposal is contained in paragraph III.B of this SNPRM.	
Paragraph § 417.107(b) of the October 2000 NPRM proposed that a launch operator would be required to conduct all launches in accordance with the proposed public risk criteria. This SNPRM changes the wording of paragraph § 417.107(b) to clarify that a launch operator's flight safety analysis must demonstrate that any proposed launch satisfies the public risk criteria. This modification is meant as a clarification and does not represent a change to the proposed requirements.	
Paragraph § 417.107(b)(1) has been modified and would require that a launch operator initiate the flight of a launch vehicle only if the total risk associated with the flight to all members of the public, excluding those members of the public in waterborne vessels and aircraft, does not exceed an expected average number of 0.00003 casualties ($E_C \leq 30 \times 10^{-6}$) from hazards due to impacting inert and explosive debris, $E_C \leq 30 \times 10^{-6}$ for toxic hazards, and $E_C \leq 30 \times 10^{-6}$ for far field blast overpressure hazards. The **FAA** proposes in this SNPRM that a launch operator may initiate flight only if the total risk associated with the flight satisfies the criteria. The **FAA** proposes to add the term "total" to clarify that the risk criteria applies to all phases of flight, including both the uprange and downrange portions. See also 14 CFR 415.35. The **FAA** proposes to identify both types of impacting debris with specificity because it wants to avoid confusion regarding what kinds of debris a debris risk assessment has always addressed. The **FAA** proposes to specify both because it is possible that either type of debris or a combination could exceed the expected casualty risk criteria, and the **FAA** wants to ensure that both are addressed. The **FAA** proposes here to change the name of the hazard from distant focus overpressure to far field blast overpressure to better reflect that a flight safety analysis must account for any potential source of overpressure due to explosions during launch vehicle flight that may cause window breakage. not just that caused by debris impacts. which is typically described as distant focus overpressure. The **FAA** proposes to determine	

FAA SNPRM	Comment
whether to approve public risk due to any other hazard associated with the proposed flight of a launch vehicle on a case-by-case basis. The E_C criterion for each hazard would apply to each launch from lift-off through orbital insertion, including each planned impact, for an orbital launch, and through final impact for a suborbital launch.	
Proposed § 417.107(b)(2) has been modified to change the individual risk criterion from probability of casualty (P_C) $P_C \leq 1 \times 10^{-6}$ to $E_C \leq 1 \times 10^{-6}$, to clarify that the criterion would be applied to each hazard, and would exclude persons in waterborne vessels and aircraft. This proposed change would delete all but the first sentence of § 417.107(b)(2) as proposed in the NPRM. Comments received from the Air Force indicated that the use of P_C as a risk criterion is not consistent with the definition of risk. The changes do not represent any new requirements. They are being proposed to improve clarity and to achieve consistent terminology with the ranges. The proposed addition of the flight safety analysis requirement at the beginning of § 417.107(b) eliminates the need to state anything further in § 417.107(b)(2).	Similar to the FAA proposed focused scientific study to determine a logical casualty expectation limit, the **FAA** and Common Standards Working Group should re-examine the 1×10^{-6} individual risk criteria with the same type of scientific study.
The SNPFW changes the NPRM proposed paragraph § 417.107(b)(3) by deleting all but the first sentence. The addition of the flight safety analysis reference in § 417.107(b) eliminates the need to state anything further in § 417.107(b)(3). A launch operator would initiate flight only if, the probability of debris impact to all water-borne vessels (P_{iv}) that are not operated in direct support of the launch does not exceed 0.00001 ($P_{iv} \leq 1 \times 10^{-5}$) in each debris impact hazard area of § 417.223. To achieve commonality with the Air Force, the SNPRM eliminates the use of the term "collective risk' and states the proposed criterion in terms of probability of debris impact to all water-borne vessels to express the collective risk concept. For example, if there were five vessels in the vicinity of the launch, in order to initiate flight, a launch operator would have to demonstrate that if each vessel's individual probability of impact at the time of flight were calculated and those five probabilities were added together, the total would satisfy the criterion. The reference to the requirements for impact hazard areas has been changed to "each debris impact hazard area of § 417.223" to reflect organizational changes and the performance level flight hazard area analysis requirements proposed in the SNPRM.	Similar to the FAA proposed focused scientific study to determine a logical casualty expectation limit, the FAA and Common Standards Working Group should re-examine the water-borne vessel risk limit criteria with the same type of scientific study.
Paragraph § 417.107(b)(4) in the SNPRM remains the same, minor editorial changes aside, as proposed in the NPRM. A launch operator would initiate flight only if the probability of debris impact to any individual aircraft (P_{ia}) not operated in direct support of the launch does not exceed 0.00000001 ($P_{ia} < 1 \times 10^{-8}$) in each debris impact hazard area of § 417.223. The reference to the	Similar to the FAA proposed focused scientific study to determine a logical casualty expectation limit, the FAA and Common Standards Working Group should re-examine the aircraft risk limit criteria with the same type of scientific study

FAA SNPRM	Comment
requirements for impact hazard areas has been changed to "each debris impact hazard area of § 4 17.223" to reflect organizational changes and the performance level flight hazard area analysis requirements proposed in the SNPKM.	
The FAA is requesting public comment on an alternative requirement to protect individual aircraft not operated in direct support of the launch. The FAA and Air Force Common Standards Working Group is considering a change in the proposed requirements of paragraph § 417.107(b)(4) such that the probability of impact to any individual aircraft (P_{ia}) not operated in direct support of the launch does not exceed 0.0000001 ($P_{ia} \leq 1 \times 10^{-7}$) in each debris impact hazard area. This would relax the FAA's proposed aircraft probability **of** impact standard from 10^{-8} to 10^{-7}. Such a change would be consistent with the current Range Commander Council Standard 321-00 and the FAA's "Supplemental Application Guidance for Unguided Suborbital Launch Vehicles." Such a change would not affect the currently proposed § 417.107(c)(4) which would require that the aircraft impact analysis account for all debris with the potential to impact an aircraft with 11 ft-lbs of kinetic energy or greatcr and account for the aircraft velocity.	Relaxing the proposed aircraft probability of impact and making it consistent with accepted practices at the Federal Ranges is welcomed as it is consistent with industry desires for a single set of flight safety requirements.
The SNPRM proposes new paragraph § 417.107(c) that would require a launch operator's flight safety analysis to account for any inert debris impact with a mean expected kinetic energy at impact greater than or equal to 11 ft-Ibs and, except for the far field blast overpressure effects analysis of § 417.229, a peak incident overpressure greater than or equal to 1.0 psi due to any explosive debris. The 11 ft-lbs threshold for inert debris would apply when determining expected casualties due to blunt trauma. The 1.0 psi threshold for explosive debris would apply when determining expected casualties due to overpressure effects. The far field blast overpressure effects analysis of proposed § 417.229 would account for overpressure levels below 1.0 psi that could cause window breakage and related casualties due to falling or projected glass shards. The SNPRM also proposes that, when using the dcbris thresholds to determine potential casualties, a flight safety analysis would use either probabilistic models or a more simple and conservative approach. The FAA and Air Force Common Standards Working Group is considering these debris thresholds as proposed common launch safety requirements. The FAA is requesting public comment on the proposed use of these thresholds. **A** complete discussion on the proposed thresholds and their applicability is provided in section III.C of this SNPRM.	The preamble contains a lengthy discussion on probabilistic models which are costly and not realistic. FAA provide examples of "a more simple and conservative approach"
In addition, § 417.107(c) would clarify that a flight safety analysis would be required to apply the thresholds for inert and explosive debris to demonstrate	The requirement to count each person within the 1.0 psi pressure area and each person in any building in the area as casualties is overly conservative

FAA SNPRM	Comment
whether a launch satisfied the probability of impact criterion for water-borne vessels of § 417.107(b)(3) and the probability of impact critcrion for aircraft of § 417.107(b)(4). Proposed § 417.107(c)(4) would require the analysis to account for the aircraft velocity. Accounting for the aircraft velocity is important when determining the kinetic energy of a potential debris impact with the aircraft. Accounting for the aircraft's velocity is not a new proposal. It was included in appendix **A** of the NPRM and is being added to proposed § 417.107(c)(4) to clarify that it is an important part of the criterion.	considering the discussions in paragraph IIIC2 of the SNPRM where it is acknowledged that the casualty rate in this exposure would be low.
The SNPRM proposes a new paragraph § 417.107(d), which would require that a probabilistic casualty model used by a launch operator must be based on accurate data and scientific principles and be statistically valid. A launch operator would be required to obtain FAA approval of any probabilistic casualty model that is used in thc flight safety analysis. If the launch takes place from a federal launch range, the analysis would be allowed to employ any probabilistic casualty model that is accepted as part of the FAA's baseline assessment of the federal launch range's safety process. The proposed provisions for the use of probabilistic models as part of a launch operator's flight safety analysis are intended to provide greater flexibility in demonstrating that a proposed launch satisfies the public risk criteria and to provide greater consistency with the current practices at federal ranges. A complete discussion on the use of probabilistic models as part **of** flight safety analysis in provided in conjunction with the discussion on casualty thresholds in paragraph III.C of this SNPRM.	The FAA, in conjunction with the Common Standards Working Group, should provide launch operators with an FAA and Federal Range approved probabilistic human casualty model in an Advisory Circular or other similar document. Launch operators may then use this model at their own discretion to reduce the conservatism introduced by using a standard model. Requiring an expensive model!! "Based on accurate data"- will the FAA provide data they feel is accurate. otherwise where is a good data source? A good model for the launch sites may exist, but will be impossible for all possible down range potential impact locations.
The SNPRM re-letters § 417.107(c), (d), (e) and (f) as proposed in the NPRM to (e), (f), (g), and (h) respectively. The title ofproposed § 417.107(e) has been changed from "Conjunction on launch assessment" to "Collision avoidance." This change is being made to reflect common terminology used at the federal ranges. The references to subpart C and appendix A in the last sentence of proposed paragraph § 417.107(e) have bccn modified to be consistent with the other changes made by this SNPRM.	No Comments.
The second and third sentences of proposed paragraph § 417.107(f) have been replaced with a reference to § 417.203(d) that contains provisions for when a flight safety analysis performed by a federal range for a licensed launch may be treated as the licensed launch operator's analysis. This change is meant to clarify that at a federal range, licensed launch operators need not perform analysis ordinarily performed by the range. This is consistent with the FAA's current practice of accepting the federal range process through its baseline assessments. The public comments on the original NPRM indicated that there was significant misunderstanding with regard to this issue, ana this	It is still unclear what is encompassed by the FAA approval through the baseline assessments. In this paragraph, the baseline assessment is described as an acceptance of the "federal range process." This appears to potentially embody more than just thc analyses completed by thc Range, perhaps a larger scope that would include all launch operator submittals to the Range that arc approved by and used by the Range in their "process." What is the scope of the baseline assessments'! See original comments to the NPRM on 417.113

FAA SNPRM	Comment
change is intended to clear up that misunderstanding.	
This SNPRM changes the title of proposed paragraph 417.121(c) from "Conjunction of launch" to "Collision avoidance" to reflect common terminology used at the federal ranges.	
The remaining changes that this SNPRM proposes to make to subpart B of part 417 involve references made to sections of proposed subpart C of part 417. This SNPRM modifies and reorganizes proposed subpart C of part 417. As a result, a number of references made in proposed subpart B of part 417 to sections in subpart C of part 417 must be changed accordingly.	

FAA SNPRM	Comment
Subpart C, Flight Safety Analysis	
Subpart C contains proposed requirements governing performance of flight safety analysis to demonstrate a launch operator's capability to manage risk to the public from normal and malfunctioning launches. As originally proposed, subpart C in the NPRM contained both performance level flight safety analysis requirements and additional detailed requirements regarding how to satisfy the performance standards. Comments received from the public as well as the Common Standards Working Group indicated that subpart C of the original NPRM contained detail beyond the performance level, and not all the detail described flight safety analysis methods used by the ranges. In addition, commenters were concerned that proposed subpart C rigidly mandated an approach to performing some of the flight safety analyses, even though more than one acceptable approach might exist. Accordingly, to reflect the Common Standards Working Group understandings regarding common flight safety analysis performance requirements, the FAA now proposes to separate the performance standards from the more detailed mcthodology requirements, which are now proposed in appendix A. Although the NPRM provided that the FAA would accept alternate analyses if a launch operator provided a clear and convincing demonstration of an equivalent level of safcty, 14 CFR § 417.203(f) (proposed in the October 2000 NPRM), the FAA madc this organizational change to promote the understanding that it has the ability to accept alternate approaches. A launch operator who satisfied the subpart C requirements with an alternate analysis would not need to use appendix A. This is thc FAA's intent for licensed launches that take place at a federal launch range where the FAA baseline safety assessment of the federal range will document the range's implementation of the subpart C requirements. Appendix A requirements would typically apply for licensed launches from non-federal launch sites. As part of the effort to develop common launch safety requirements, the FAA worked with the federal ranges to develop the performance level requirements for flight safety analysis presented in this SNPRM.	While it is commendable that the FAA has chosen to move the detailed analysis methods to an Appendix, it would still be more appropriate to remove them from the NPRM/SNPRM entirely and instead publish them in an Advisory Circular. It should be clearly stated that no additional analyses or data is required under this subpart provided the range user is launching from a federal range and an acceptable FAA baseline assessment is in effect. If this is the case then the existing range safety process, including analyses and data requirements, would be followed. Note that this is no different than the existing FAA/Range practice.
This SNPRM proposes a rewritten subpart C that only contains performance requirements for flight safety analysis developed by the Common Standards Working Group (CSWG). The intent is for each section of subpart C to contain common performance requirements agreed to by the Air Force and the FAA that apply to flight safety analysis, regardless of who performs the analysis, with the understanding that the methodologies implemented to satisfy the performance requirements may vary. The public comments on the original NPRM also indicated that there was significant misunderstanding	Despite thc FAA's efforts in this area, it is still unclear what analysis products a launch operator will have to submit to the FAA when launching from a federal range. The FAA must publish a baseline assessment that clearly identifies, by paragraph number, which **of** the Part 417 requirements arc satisfied when launching from a fcdcral range.

FAA SNPRM	Comment
with regard to the proposed administrative requirements associated with flight safety analysis. The revised subpart C in this SNPKM contains modifications to clarify when a launch operator would be required to perform analyses and submit analysis products to the **FAA** and when the launch operator would not, depending on whether a launch is from a federal range or a non-federal launch site.	
There are criteria that apply to the methodologies used to perform flight safety analysis that are necessary to define the acceptable level of fidelity and, when satisfied, ensure consistent analysis results from one launch to the next. Where the federal ranges typically strive to ensure that their analysis methodologies are the state of the art, the **FAA's** regulations must include methodology requirements that ensure consistent analysis results for launches from non-federal launch sites. Therefore, the analysis methodology requirements that were in the original subpart C of the October 2000 NPRM have been streamlined and are now contained in appendix **A** with only a few matcrial changes to better reflect current practice. In addition, the requirements for analysis products that would have to be submitted to the **FAA,** depending on whether the analysis was performed by a federal range or thc launch operator and in accordance with any specific terms of the license, have been revised and moved to appendix **A** (see discussion on revised appendix **A).**	It is still unclear what, if any, analysis products need to be submitted to the **FAA** when a launch operator is launching from a federal range. The baseline assessment for each federal range should be explicitly clear about this.
The title of § 417.201 is now proposed as "scope and applicability." Subpart ***C*** would contain performance requirements for a flight safety analysis to be performed as required by $ 417.107(d). **As** was proposed in the original NPRM, the flight safety analysis requirements of § 417.233 would apply to the flight of any unguided suborbital launch vehicle that uses a wind weighting safety system. **All** other analyses required by subpart C would apply to the flight of any launch vehicle that is required to use a flight safety system in accordance with § 417.107(a). **A** major concern raised in the public comments to the original NPRM was that many of the analysis requirements in subpart C may not apply depending on the specifics of an alternative flight safety system. The last sentence of revised § 417.201 would clarify that for any alternative flight safety system approved by the **FAA** in accordance with 417.107(a)(3), the applicability of the analysis requirements in subpart C would be determined during the licensing process, which is current practice.	No Comments.
Section 417.203 now contains proposed requirements related to how a launch operator would demonstrate compliance with the flight safety analysis requirements. The requirements of § 417.203(a) and (b) were taken from § 417.203(a) of the original NPRM. A new sentence was added to the end of	No Comments.

FAA SNPRM	Comment
417.203 (a) to clarify that a launch operator's flight safety analysis may rely on a previously accepted analysis for an identical or similar launch if the analysis still applies to the later launch. This change was made in response to comments expressing concern that a launch opcrator might be required to unnecessarily repeat analyses, which was not the intent of the **FAA** original proposal in the NPRM.	
Proposed section 417.203(c) reflects the fact that the **FAA** anticipates that different launch operators will employ different methods for satisfying the requircmcnts of proposed subpart C. In the course of the licensing process thc **FAA** would approve an alternate flight safety analysis if a launch operator provided a clear and convincing demonstration that its proposed analysis provided an equivalent level of safety to that required by proposed subpart C. **A** launch operator would be required to demonstrate that an altemate flight safety analysis was bascd on accurate data and scientific principles and was statistically valid. Thc **FAA** would not find the launch operator's application for a license or license modification sufficiently complete to begin review until the **FAA** approved the alternate flight safety analysis. Accordingly, a launch operator may not change its methods for conducting a flight safety analysis without **FAA** approval. **A** launch operator would have to submit any change to its flight safety analysis methods to the **FAA** as a request for license modification prior to proceeding with the proposed launch. § 417.203(c) in the SNPRM was taken from § 417.203(f) of the October 2000 NPRM and provides for flexibility by allowing for alternate flight safety analysis methods.	Current practices at federal ranges include partial submittals, usually outlined by informal negotiations, when awaiting complete submittals is not practical. Thc **FAA** should not take the position that it will not even begin reviewing a launch license application until all discussions involving alternate analyses are completed. This position is very harmful to the promotion of commercial launch business by potentially creating unnecessary delays. Review of partial submittals should be worked in parallel with approval of altemate analysis methods.
Proposed § 417.203(d) has been added to address the issue of licensed launches that involvc fcdcral ranges. The **FAA** would accept an alternate flight safety analysis used by a federal launch range for a licensed launch, if the **FAA** documented and approved the altemate flight safety analysis in the **FAA** baseline safety assessment of that federal launch range. In this case the **FAA** would treat the federal launch range's analysis as that of the launch operator and the launch operator would not need to provide any further demonstration of compliance. Licensees are advised to remember that there arc different procedures for complying with part 417, depending on whether a launch takes place from a federal launch range or from a non-federal launch site. **For** a licensee proposing to launch from a federal launch range where an **FAA** assessment shows that the safety services of that range are acceptable, the licensee would not need to provide the **FAA** any additional information to comply with subpart **C.** Only if one of the range safety analysis methods did not satisfy a subpart C requirement wouid a iaunch operator have to	It is unclear what, specifically, is approved through thc baseline assessment. If approval of the safety services at a federal range includes approval of all launch operator analysis methods that are accepted by the federal range, thc wording in Part 417 should explicitly say so.

FAA SNPKM	Comment
demonstrate satisfaction to thc **FAA.** Additionally, if an **FAA** baseline assessment showed that a proposed liccnscd launch from a federal range was in some way outside the experience of the range, the licensee would also have to address any outstanding issues with the **FAA,** which is current practice under the **FAA's** current regulations. Thus, although thc part 4 17 rcquircments apply to a licensee proposing to launch from a fcdcral launch range, this rulemaking does not require the licensee to change its practices at the range. Only changes in range practice would result in a change for the launch licensee. **A** licensee proposing to launch from a launch site for which no federal launch range provides safety services would, of course, have to demonstrate compliance with all applicable requirements to the **FAA.**	
Proposed § 417.203(e) would now contain the timing requirements for submitting analysis products to the **FAA** as wcrc proposed in the original NPRM. § 417.203(e) would further clarify that the requirements for submitting analysis products apply for licensed launches that do not qualify for the provisions of paragraph (d) of this section, that is. thc requirements for submitting analysis products would apply to analyses that have not been performed by a federal range. The analysis products that were in the various sections of subpart C of the original NPRM have been streamlined and moved to appendix **A** as discussed below. The license application analysis submittal requircmcnts in § 417.203(e)(1) are repeated without change from § 417.203(c)(1) of the original NPRM. The six-month submittal requirements of § 417.203(e)(2) are unchanged from § 417.203(c)(2) of the original NPRM; however, paragraph (iii) was added to clarify that if an analysis product has not changed since the launch operator's license application submittal, the launch operator's six-month submittal need not repeat the data. Thc thirty-day submittal requirements remain unchanged from § 417.203(c)(3) of the original NPRM; however the second sentence was added to clarify that if an analysis product has not changed since the since the six-month analysis submittal, the launch operator's thirty-day submittal need not repeat the data. Proposed § 417.203(e)(4) has been added to provide clarification on how a programmatic flight safety analysis would bc treated. **A** launch operator would not be required to submit the 6-month analysis or 30-day analysis update for a launch if the launch operator submitted complete analysis products during the licensing process and demonstrated that all parts of the analysis applied to each launch to be conducted under the license and that the analysis did not need to be updated to account for launch specific factors.	The analysis due dates required here are unreasonable and inconsistent with current federal range practices. Many of the analyses completed by the launch operator are not due to the federal range until either L- 120 or **L-60.** Many of the analyses completed by the federal range are not completed until just a few weeks or even days prior to launch.
Proposed § 417.205 would now contain general performance requirements	No Comments.

FAA SNPRM	Comment
that apply to all the various sub-analyses that make up a flight safety analysis. The first sentence of paragraph § 417.205(a) contains the same requirement for controlling risk to the public as the first sentence in § 417.203(a) of the original NPRM, except that the requirements are now placed on the flight safety analysis regardless of who performs the analysis. The **FAA** intends this editorial change to clarify that the analysis may be performed by the launch operator or a federal range. The remainder of § 417.205(a) of the SNPRM proposes new performance requirements for how an analysis demonstrates control of risk by employing risk assessment or hazard isolation or a combination of both. The ranges have historically preferred the use of hazard isolation over risk assessment as the safer approach to the extent practicable. The **FAA** does recognize that most launches from the ranges reflect a combination of hazard isolation and risk assessment. The FAA agrees that hazard isolation is preferable; however, because a regulation must identify the acceptable limit for purposes of safety, admonitions to use the safer of two acceptable options are not readily codified. The **FAA** does, however, expect hazard isolation to be the method of choice whenever practical while permitting a combination or choice of either approach. Hazard isolation not only offers the safer approach, it also tends to be analytically easier to demonstrate satisfaction of the requirements. Risk assessment may, however, while requiring more analysis to prove satisfaction of the requirements, also provide greater operational flexibility on the day of launch.	
Proposed paragraph § 417.205(b) contains performance requirements for the input and output of dependent analyses to be compatible to ensure accuracy of the analysis products and is essentially the same as § 417.203(e) of the original NPRM.	No Comments.
Proposed section 417.207 of the SNPRM contains the performance requirements that would apply to any trajectory analysis. § 417.207 does not contain any new requirements as compared to the October 2000 NPRM. § 417.207 combines § 417.205(a) of the October 2000 NPRM with the general requirements that were in other paragraphs of § 417.205 of the NPRM and reflects input from the CSWG to better capture current practice at the Air Force ranges. The remaining trajectory analysis methodology requirements that were proposed by § 417.205 of the October 2000 NPRM have been streamlined and moved to A417.7 of appendix **A** of part 417. Many of the other analyses, such as those performed to establish flight safety limits and hazard areas, would use the products of the trajectory analysis as input. § 417.207 would require that a trajectory analysis determine, for any time after	The **FAA** should not explicitly require a six-degree of freedom trajectory, but instead accept a "six-degree of freedom trajectory model, or equivalent."

FAA SNPRM	Comment
lift-off, the limits of a launch vehicle's normal flight. Normal flight is defined as proposed in section 417.103 the flight **of** a properly performing launch vehicle whose real-time instantaneous impact point does not deviate from the nominal instantaneous impact point by more than the sum of the wind effects and the three-sigma perforinance deviations in the uprange, downrange, left-crossrange, or right-crossrange directions. In § 417.205(f) of the October 2000 NPRM, the FAA proposed that a launch operator use a six-degree-of-freedom trajectory model to generate each required three-sigma trajectory. The FAA now proposes to require that only the final trajectory analysis must employ a six-degree of freedom trajectory model because the CSWG concluded that three-degree of freedom trajectory models may satisfy preliminary trajectory analysis requirements. The **FAA** proposes to delete the use of instantaneous impact point distance from its nominal location as a reference because specifying the reference might appear to rule out other acceptable alternatives. The FAA is making this change to allow for greater flexibility.	
Proposed section 417.209 of the SNPRM contains the performance requirements that would apply to any malfunction turn analysis. Proposed section 417.209 combines § 417.207(a) of the October 2000 NPRM with the more general requirements that were in other paragraphs of § 417.207 of the NPRM and reflects input from the CSWG to better capture current practice at the Air Force ranges. The remaining malfunction turn analysis methodology requirements that were proposed in § 417.207 of the October 2000 NPRM have been streamlined and moved to A417.9 of appendix A of part 417. **A** malfunction turn analysis would be required to determine a launch vehicle's turning capability using sets of malfiinction turn curves, consistent with current practice. The FAA has deleted "grcatest turning capability" from the first sentence of § 417.207(a) of the October 2000 NPRM, which is now in § 417.209 of the SNPRM. This change is being made to clarify that the products of a malfunction turn analysis are not limited to just the greatest turning capability. The greatest turning capability of the launch vehicle, which would be defined by the envelope of a set of turn curves, would bc used for establishing flight safety limits.	No Comments.
The FAA is now proposing that a malfunction turn analysis account for the relative probability of occurrence of each malfunction turn. Although not proposed in the October 2000 NPRM, this performance requirement is consistent with current practice at the federal ranges and is necessary to facilitate use of risk analysis, which is an option that may provide a launch operator greater flexibility. Malfunction turns arc typically described in terms	Requiring a probability ofoccurrence for each malfiinction turn in not a current practice at federal ranges. In any event, this type of speculative probability analysis is time consuming and not value added because it cannot be verified.

FAA SNPRM	Comment
of either their cause or effect. The FAA proposes that a malfunction turn analysis account for the cause in order for probabilities to be assigned, and the effects in order to assess debris impact probabilities. Typical causes of malfunction turns include thrust offset and burn through. Thrust offset may include failures in the gimbals or in the flow of thrust vector control fluid. A nozzle burn through may result in an imbalance in the thrust. If a nozzle breaks off, the loss may produce an imbalance in the thrust of the launch vehicle and consequent changes in its velocity vector. Launch vehicle systems such as the examples discussed above and others that could be the cause of a malfunction turn may fail in many ways. If a flight safety analysis is to make greater use of risk analysis the causes of possible malfunction turns need to be identified and their probabilities determined.	
Proposed section 417.211 of the SNPRM contains the performance requirements that would apply *to* any debris analysis. § 417.211 does not contain any new requirements as compared to the October 2000 NPRM; however, the provisions of the NPRM have been reorganized, and modifications are proposed to better reflect current practice at the federal ranges. § 417.211 combines § 417.209(a) of the October 2000 NPRM with some general requirements from other paragraphs of § 417.209 of the NPRM. The remaining debris analysis methodology requirements that were in § 417.209 of the October 2000 NPRM have been streamlined and moved to A417.11 of appendix A to part 417.	No Comments.
Section 417.211 would require a debris analysis to identify the inert, explosive, and other hazardous launch vehicle debris that results from normal and malfunctioning launch vehicle flight. A debris model would consist of lists of the debris fragments that are planned as part of a launch or that result from breakup of the launch vehicle. The lists would account for and describe all debris fragments and their physical characteristics. These debris lists would be necessary as input to other flight safety analyses such as those performed to establish flight safety limits and hazard areas and to determine if the launch satisfies the public risk criteria.	No Comments.
Proposed section 417.213 of the SNPRM contains the performance requirements that would apply to flight safety limits analysis and would capture current practice at the federal ranges. § 417.213 does not contain any new requirements as compared to the October 2000 NPRM; however, the provisions of the NPRM have been reorganized. § 417.213 combines § 417.213(a) of the October 2000 NPRM with the performance requirements from other paragraphs of $417.213 of the NPRM. The remaining flight safety limits analysis methodoiogy requirements that were in § 417.213 of the	No Comments.

FAA SNPRM	Comment
NPRM have been streamlined and moved to A4 17.I3 of appendix **A** to part 4 17. § 417.21*3* also combines specific flight control lines analysis requirements from § 417.21 1 of the October 2000 NPRM. The SNPRM would eliminate the requirement for a separate flight control line analysis. The flight control lines analysis was proposed in the NPRM to identify the protected areas and account for map and tracking errors. The **FAA** now proposes to include the identification of protected areas and accounting for map and tracking errors as part of the flight safety limits analysis.	
Proposed section 4 17.2l 3 would require a flight safety limits analysis to identify the location of populated or other protected areas and establish flight safety limits that define when a flight safcty official must terminate a launch vehicle's flight to prevent the hazardous cffccts of the resulting debris impacts from reaching any populated or other protected area and ensure that the launch satisfies the public risk criteria of § 417.107(b). The public risk management requirements of proposed § 417.205(a), in general, allow a flight safety analysis to employ risk assessment or hazard isolation, or a combination of risk assessment and partial isolation of the hazards to demonstrate control of the risk to the public. Because flight safety limits are to be implemented for the specific situation when a malfunctioning launch vehicle is heading for a protected area, the FAA proposes that the flight safety limits should provide for a measure of isolation from impacting debris hazards. Were risk the sole measure used to establish flight safety limits, a low probability of launch vehicle failure might result in flight safety limits that would not represent the boundaries of safe flight in the event of a failure.	No Comments.
Although flight safety limits provide a form of hazard isolation, they must also reflect and support how a launch satisfies the public risk criterion for debris. Current practice provides a good example of how this approach works. At the Eastern Range, the 45th Space Wing establishes destruct lines, which constitute one kind of flight safety limit, to prevent debris with a ballistic coefficient of three[1] or more from reaching protected areas. Nonetheless, debris with a ballistic coefficient of less than three may still reach protected areas and may cause casualties, as discussed previously. A flight safety analysis would assess the "residual risk," risk due to any hazard not isolated from the public, to determine whether the public risk criterion is satisfied. The FAA proposes in this SNPRM to require that the debris risk assessment of proposed section 417.225 account for the risk due to debris	No Comments.

[1] As proposed in appendix A of part 417 of this SNPRM, the FAA proposes to rely on a ballistic coefficient of three to establish flight safety limits.

FAA SNPRM	Comment
with kinetic energy at impact of 11 ft-lbs. With this measure of what may cause a casualty, the risk assessment may show that flight safety limits designed *to* isolate debris with a ballistic coefficient of three still permit too much risk due to more wind sensitive debris pieces with ballistic coefficients of less than three. For example, a large number of small pieces of debris or large crowds at the edge of the flight safety limits might increase risk *to* unacceptable levels. In that case, the **FAA's** proposed requirements would mandate that the flight safety limits be adjusted to ensure that the launch satisfied the public risk criteria of proposed section 417.107(b). If the flight safety limits were designed to isolate debris with a kinetic energy of 11 ft-lbs at impact, there would be no need to assess the residual risk due to debris outside of the flight safety limits. Of course, a flight safety analysis would still need to assess the risk due to the potential for flight termination system failure.	
Proposed section 417.215 of the SNPRM contains the performance requirements that would apply to any straight-up time analysis and captures current practice at the federal ranges. § 417.215 does not contain any new requirements as compared to the October 2000 NPRM; however, the provisions of the October 2000 NPRM have been reorganized. Proposed section 417.215 combines § 417.215(a) of the October 2000 NPRM with the top-level requirements that were in other paragraphs of § 417.215 of the October 2000 NPRM. The remaining straight-up time analysis methodology requirements that were in § 417.215 of the October 2000 NPRM have been streamlined and moved to A417.15 of appendix **A** to part 417. **A** straight-up time analysis would be required to establish the straight-up time as the latest time after liftoff, assuming a launch vehicle malfunctions and flies in a vertical or near vertical direction above the launch point, at which activation of the launch vehicle's flight termination system or breakup of the launch vehicle would not cause hazardous debris or critical overpressure to affect any populated or other protected area. Straight-up time is a special type of flight safety limit used **to** address this specific type of failure. In the event of such a failure, the flight safety official would terminate flight at the straight-up time to ensure that hazardous debris effects do not extend to populated or other protected areas.	No Comments.
Proposed section 417.217 of the SNPRM contains the performance requirements that would apply to any no longer terminate gate analysis and captures current practice at the federal ranges. § 417.217 does not contain any new requirements as compared to the October 2000 NPRM; however, the provisions ofthe October 2000 NPRM have been reorganized. Section	No Comments.

FAA SNPRM	Comment
417.217 combines § 417.219(a) of the October 2000 NPRM with the performance requirements that were in other paragraphs of § 417.219 of the October 2000 NPRM. The remaining analysis methodology requirements that were in § 417.219 of the October 2000 NPKM have been streamlined and moved to A417.17 of appendix **A** to part 417.	
A no longer terminate gate analysis would be required to determine the portion, referred to as a gate, of a flight safety limit, through which a launch vehicle's tracking icon is allowed to proceed without a launch operator being required to terminate flight. **A** tracking icon is the representation of a launch vehicle's position in flight available on a flight safety official console during real-time tracking of the launch vehicle's flight. The products of a no longer terminate gate analysis are necessary for establishing flight termination rules for any planned launch vehicle flight over a populated or other protected area. Once a launch vehicle traversed a gate, flight would not be terminated while the vehicle's debris impact dispersion footprint was over the protected area.	No Comments.
Proposed section 417.219 of the SNPRM contains the performance requirements that would apply to any data loss flight time analysis and captures current practice at the fcdcral ranges. § 417.219 does not contain any new requirements as compared to the October 2000 NPRM; however, the provisions of the October 2000 NPRM have been reorganized and some modifications have been made to better reflect current practice at the federal ranges. § 417.219 combines § 417.221(a) of the October 2000 NPRM with the performance requirements that were in other paragraphs of § 417.221 of the October 2000 NPRM. The remaining analysis methodology requirements that were in § 417.221 of thc October 2000 NPRM have been streamlined and moved to A417.19 of appendix A to part 417.	No Comments.
Proposed section 417.219 would require a flight safety analysis to establish data loss flight times and a no longer terminate time for use in establishing flight termination rules that apply when launch vehicle tracking data is not available to the flight safety official. **A** data loss flight time would be the shortest elapsed thrusting time during which a launch vehicle could move from its normal trajectory to a condition where the launch vehicle's hazardous debris impact dispersion extended to any protected area. A flight safety official uses data loss flight times as the longest time he would wait before terminating flight when launch vehicle tracking data became unavailable. Current practice recognizes that loss of tracking data does not necessarily mean that a launch vehicle failure has occurred. The launch may continue in the absence of tracking data, but only for the period of time that the launch vehicle debris impact dispersion could not reach a protected area. The	No Comments.

FAA SNPRM	Comment
analysis would assume that a malfunction occurred when the tracking data was lost and that the launch vehicle headed for the nearest protected area. If tracking was not restored before the launch vehicle debris impact dispersion could reach the protected area, the flight would have to be terminated. Although the October 2000 NPRM proposed that the time describe the shortest elapsed time in which public endangerment could become possible, because current practice only accounts for debris as a hazard for purposes of determining flight safety limits, the FAA proposes to modify this provision to reflect the true nature of the concern: namely, debris impacts. Because the earliest destruct time is in fact the first data loss flight time, the SNPRM eliminates as redundant all references to the earliest destruct time. A flight safety analysis would also determine the no longer terminate time for a launch, which would replace the term "no longer endanger time." The CSWG recommended that the **FAA** propose this change in terminology because no longer endanger time has different uses at different ranges and in some cases may be some what of a misnomer. No longer terminate time is a more generally applicable term that better reflects its actual implementation. The SNPRM proposes to provide streamlined definitions and requirements for data loss flight times and the no longer terminate time that are consistent with current practice. The analysis for no longer terminate time would establish the time after liftoff that a launch vehicle's hazardous debris impact dispersion could no longer reach any protected area from that time forward to final impact or orbital insertion as the no longer terminate time for the launch. Different federal ranges use different terminology for data lose flight times and no longer terminate time. The **FAA** is proposing the use of generic terms and requirements that, for all intents and purposes, are consistent with current practice at the federal ranges.	
The SNPRM contains a modification to better reflect currcnt practice at the federal ranges for launches where a gate permits overflight of a protected area and where orbital insertion occurs after reaching the gate. In such cases, the no longer tertninate time would be the time after liftoff when the time for the launch vehicle's instantaneous impact point to reach the gate is less than the time for the instantaneous impact point to reach any flight safcty limit. Current practice embraces this approach for at least two reasons. If a launch vehicle performs normally until that point in its trajectory, it will almost certainly enter the gate. If flight were terminated after that time, there would be a greater likelihood of debris impacting the protected area than if the flight were allowed to continue.	No Comments.
Proposed section 417.221 ofthe SNPKM contains the performance	No Comments.

FAA SNPRM	Comment
requirements that would apply to any time delay analysis and captures current practice at the federal ranges. § 417.221 does not contain any new requirements as conipared to the October 2000 NPRM; however, the provisions of the October 2000 NPRM have been reorganized. § 417.221 combines § 417.223(a) of the October 2000 NPRM with the requirements that were in other paragraphs of § 417.223 of the October 2000 NPRM. The remaining analysis methodology requirements that were in § 417.223 of the October 2000 NPRM have been streamlined and moved to A417.21 of anoendix **A** to Dart 417.	
Proposed section 417.221 would require a time delay analysis to determine the mean elapsed time between the violation of a flight termination rule and the time when the flight safety system is capable of terminating flight so that flight termination would occur. **A** time delay analysis would have to account for all sources of tinie delay that could have an effect on identifying when a launch vehicle malfunction occurred and how quickly flight could be terminated once a malfunction was identified. Proposed § 417.221 would clarify that a time delay analysis would be required to account for the variance of time delays for each potential failure scenario, including but not limited to, the range of malfunction turn characteristics and the time of flight when the malfunction occurred.	No Comments.
Proposed section 417.223 of the SNPRM contains the performance requirements that would apply to any hazard area analysis and captures current practice at the federal ranges. § 417.223 does not contain any new requirements as compared to the October 2000 NPRM; however, the provisions of the October 2000 NPRM have been reorganized. § 417.223 contains the requirements that were in § 417.225(a) of the October 2000 NPRM. The remaining analysis methodology requirements that were in § 417.225 of the October 2000 NPRM have been streamlined and moved to A417.23 of appendix **A** to part 417.	No Comments.
The **FAA** would require a flight hazard area analysis to identify any regions of land, sea, or air that must be monitored, publicized, controlled, or evacuated to control the risk to the public from debris impact hazards. The risk management requirements of § 417.205(a) would apply. Proposed section 417.225(a) of the October 2000 NPRM stated that hazard areas must be implemented to "ensure public safety." The requirements for satisfying the various public risk criteria were spread throughout other paragraphs in § 417.225 of the October 2000 NPRM. In keeping with the intent of defining the performance requirements, the new proposed section 417.223 now states that the risk management requirements of proposed § 417.205(a) would	No Comments.

FAA SNPRM	Comment
apply. Managing the risk to the public, which involves employing risk assessment or hazard isolation, or a combination of risk assessment and partial isolation of the hazards to demonstrate control of the risk to the public and that the public risk criteria are satisfied as required by proposed § 417.205(a), in effect, provides for the necessary assurance of public safety. Consistent with current practice at the federal ranges, the analysis would account for, but need not be limited to, regions of land potentially exposed to debris resulting from normal flight events and events resulting from any potential malfunction, regions of sea and air potentially exposed to debris from normal flight events, including planned impacts, and in the vicinity of the launch site, any waterborne vessels or aircraft exposed to debris from events resulting from any potential abnormal flight events, including launch vehicle malfunction.	
For sea and air regions beyond the vicinity of the launch site, a typical flight hazard area analysis would only account for normal flight events, including planned impacts. Historically, the probability of impacts to aircraft and waterborne vessels due to potcntial launch vehicle malfunctions has been significant only during the initial stages of flight that take place in the vicinity of the launch site. Typically, once a launch vehicle is beyond the vicinity of the launch site the impact dispersions are large enough and the instantaneous impact point moves fast enough that the probability of impacts to aircraft and waterborne vessels due to potential launch vehicle malfunctions is negligible in comparison to those in the vicinity of the launch site. Furthermore, the probability of a launch vehicle malfunction is typically at its highest during the initial stages of flight, which generally includes the point where the vehicle experiences the maximum dynamic pressure. Once a launch vehicle has completed the initial stages of flight and is beyond the vicinity of the launch site, aerodynamic forces on the launch vchicle are generally small duc to the reduced atmospheric density at high altitudes. However, proposcd § 417.205(a) would require the analysis to identify any regions of land, sea, or air that must bc monitored, publicized, controlled, or evacuated in order to control the risk to the public from debris hazards and would not limit where flight hazard areas may need to be established.	No Comments.
Proposed section 417.225 of the SNPRM contains the performance requirements that would apply to any debris risk analysis and includes requirements for the debris thresholds to be applied when calculating debris risk. The current practice for debris risk analysis may vary from launch site to launch site and from vehicle to vehicle. Proposed section 417.225 of this SNPRM contains proposed common performance requirements that would	No Comments.

FAA SNPRM	Comment
apply to all launches at federal ranges and non-federal launch sites. Proposed section 4 17.225 combines § 417.227(a) of the October 2000 NPRM with the requirements from other paragraphs of § 417.227 of the October 2000 NPRM. The remaining analysis methodology rcquircments that were in § 417.227 of the October 2000 NPRM have been streamlined and moved to A4 17.25 of appendix A to part 4 17.	
The FAA would require that a debris risk analysis would demonstrate that the risk to the public potentially exposed to inert and explosive debris hazards from any one flight of a launch vehicle satisfied the public risk criterion of proposed § 417.107(b)(1) for debris. A debris risk analysis would account for risk to populations on land, including regions under launch vehicle flight following passage through any gate in a flight safety limit established in accordance with § 417.217. A debris risk analysis would account for any potcntial casualties to the public in accordance with the debris thresholds and requirements of proposed § 417.107(c). The October 2000 NPRM provided that a debris risk analysis need not account for debris with a ballistic coefficient of less than three. The FAA realizes that ballistic coefficient may not be the best parameter to use as an indication of casualty. A casualty could result from dcbris with a ballistic coefficient of less than three. The revcrsc may also be true. An impact of debris with a ballistic coefficient just greater than three might not rcsult in casualty. The FAA in coordination with the Air Force has reviewed the recent human vulnerability modeling results and believes that, for typical space launch vehicle debris masses and shapes, for the purposes of a debris risk analysis, it is reasonable to consider the potential for casualty due to blunt trauma when a human is subjected to any inert debris impact with a mean expected kinetic energy greater than or equal to 11 ft-lbs. Further discussion and results of the research on this issue are provided in paragraph III.C.1 of this notice. Proposed section 417.225 would now reference proposed § 417.107(c), which requires that an analysis account for inert debris impacts with mean expected kinetic energy at impact greater than or equal to 11 ft-lbs.	No Comments.
The October 2000 NPRM proposed that in a debris risk analysis, the effective casualty area of any explosive debris, such as solid propellant fragments that would result from break up of the launch vehicle during flight and that would explode upon impact with the Earth's surface, would account for a 3.0 psi blast overpressure radius. This is typical of current practice for analysis of people in the open. However, using a 3.0-psi blast overpressure radius is generally inappropriate for analysis of people in typical buildings. The **FAA** in coordination with the Air Force has reviewed the recent human	No Comments.

FAA SNPRM	Comment
vulnerability modeling results and now proposes that a peak incident overpressure of 1.0 psi or greatcr due to any explosive dcbris impact as a practical threshold for explosive debris, excluding window breakage effects treated in the far field blast overpressure analysis. Further discussion and results of the research on this issue are provided in paragraph III.C.2 of this notice. Proposed section 417.225 would now reference proposed § 417.107(c), which requires that the analysis account for any public risk in populated areas potentially subject to peak incident overpressure of 1.0 psi or greater due to any explosive debris impact.	
Proposed section 417.227 of the SNPRM contains performance requirements that would apply to any toxic release hazard analysis and captures current practice at the federal ranges. § 417.227 does not contain any new requirements as compared to the October 2000 NPRM; however, the provisions of the October 2000 NPRM have been reorganized. The requirements of § 417.227 were moved from § 417.229 of the October 2000 NPRM. The proposed analysis methodology requirements continue to be provided in appendix I to part 417, which remains unchanged from the October 2000 NPRM.	No Comments.
A toxic release analysis would be required to establish flight commit criteria that ensure compliance with the public risk criterion of § 417.107(b)(1). The analysis would account for any toxic release that would occur during normal or malfunctioning launch vehicle flight. The analysis would account for any operational constraints and emergency procedures that would provide protection from toxic release. The analysis would account for all members o the public on land and on any waterbomc vessels and aircraft not operated in direct support of the launch.	No Comments.
Proposed section 417.229 of the SNPRM contains the perforinance requirements that would apply to any far-field overpressure blast effects analysis, which was referred to in the NPRM as distant focus overpressure blast effects analysis. Proposed section 417.229 combines § 417.231(a) of the October 2000 NPRM with the other performance requirements from othe paragraphs of § 417.231 of the October 2000 NPRM. Section 417.229 of the SNPRM contains modified requirements with substantial streamlining and modifications made for clarity, to provide more flexibility, and to better capture current practice at the federal ranges. Section 417.229(a) combines paragraphs (a) and (c) from § 417.231 of the October 2000 NPRM. Section 417.229(a) now states that a flight safety analysis must establish flight commit criteria that ensure compliance with the public risk criterion. Thus. the SNPRM now proposes the option of performing a risk analysis to assess	How can an analysis be expected to provide a meaningful conclusion that there will be no window breakage? The intent of this requirement should be reconsidered by the FAA and redressed in a different way, such as specifying window construction requirements in protected areas to ensure against breakage under worst case blast effects.

FAA SNPRM	Comment
the potential for casualties due to window breakage consistent with the updated public risk criteria regarding blast risk. To provide greater consistency with current practice, paragraph (a) clarifies that a flight safety analysis must demonstrate that any potential source of far field blast overpressure due to explosions during launch vehicle flight, not just distant focus overpressure from debris impacts, will not cause window breakage. Alternatively, the analysis must demonstrate satisfaction of the risk criteria. The SNPRM emphasizes that the hazard of concern is "far field blast overpressure due to explosions during launch vehicle flight," which excludes consideration of potential sonic boom effects due to normal flight in this analysis. Potential sonic boom effects are typically considered in the environmental review process. Given the proposed 1.0 psi threshold for debris risk analysis, the FAA proposes that the far field blast overpressure analysis must account for any potential source of far field blast overpressure to ensure adequate public protection from potential window breakage hazards and remain consistent with current practice. Past experience at the Eastern and Western Ranges demonstrates that debris impacts are the overwhelmingly dominant source of public risk due to far field blast overpressure (peak incident overpressures below 1.0 psi). However, improperly designed flight termination systems may produce propellant explosions at altitude with the potential to break windows in protected areas.	
Section 417.229(b) would provide performance requirements that apply to any far-field blast ovcrprcssure analyses, in lieu of the prescriptive requirements proposed in the October 2000 NPRM. Although proposed paragraph (b)(5) would require an analysis to account for the characteristics of potentially affcctcd windows, including size, location, orientation, glazing material, and condition, the FAA does not intend this to require a physical survey of potentially affected public areas. Instead, reasonable assumptions based on the building construction and characteristics typical of the affected public areas may be applied to account for the characteristics of potentially affected windows. For example, as dcscribed in A417.29 of appendix A of this SNPRM, the FAA foresees that a launch operator could demonstrate that far field blast Overpressure due to potential explosions during launch vehicle flight will not cause windows to break based on the equations and assumptions of the American National Standard "Estimating Air Blast Characteristics for Single Point Explosions in Air, with a Guide to Evaluation of Atmospheric Propagation and Effects," ANSI S2.20-1983. The remaining analysis methodology requirements of § 417.23 1 of the October 2000 NPRM have been streamlined and moved to A417.29 of ab)endix A to art 417.	No Comments.

FAA SNPRM	Comment
Proposed section 417.231 of the SNPRM contains the performance rcquirements that would apply to collision avoidance analysis and captures current practice at federal ranges. Proposed section 417.231 does not contain any new requirements as compared to the October 2000 NPRM; however, the provisions of the October 2000 NPRM have bccn reorganized. Proposed section 417.231 contains the requirements that were in § 417.233(a) of the October 2000 NPRM. The title of § 417.233 in the NPRM was "Conjunction on launch assessment, '' which is a term used by United States Space Command. The SNPRM changes the title of the proposed section to "Collision avoidance analysis," to be more consistent with common terminology used at the federal ranges. The analysis methodology requirements that were in § 417.233 of the October 2000 NPRM have been moved to A417.31 of appendix A to part 417.	'o Comments.
A federal launch range will typically perform a collision avoidance analysis for any launch from that range. If no federal range is involved in the launch, the launch operator would obtain a collision avoidance analysis from United States Space Command. A launch operator would implement any waits in the launch window, as identified by United States Space Command, during which flight must not be initiated in order to maintain a 200-kilometer separation from any habitable orbiting object.	lo Comments.
Proposed section 417.233 of the SNPRM contains the performance requirements that would apply to the flight safety analysis for launch of an unguided suborbital rocket flown with a wind weighting safety system and captures current practice at fcdcral ranges. Proposed section 417.233 does not contain any new rcquircmcnts as compared to the October 2000 NPRM; however, the provisions of the October 2000 NPRM have been reorganized. Proposed section 417.233 contains the requirements that were in § 417.235(a) of the October 2000 NPRM. The remaining analysis methodology requirements that were in § 417.235 of the October 2000 NPRM have been moved to A417.33 of appendix A to part 417. The analysis would be required to establish the launch commit criteria and other launch safety rules to control the risk to the public due to potcntial adverse effects resulting from normal and malfunctioning flight and ensure satisfaction of the public risk criteria. The analysis would establish any wind constraints under which launch could occur and include a wind weighting analysis that established the launcher azimuth and elevation settings that corrected for the windcocking and wind-drift effects on the unguided suborbital rocket..	lo Comments.

FAA SNPRM Preamble	Comment
Annendix A – Flight Safetv Analvses Methodologies and Products	
The SNPRM combines requirements that were in the original appendix A to part 417 of the October 2000 NPRM with requirements moved from part 417, subpart C of the October 2000 NPRM to create a comprehensive flight safety analysis methodologies and products appendix. A417.1 would provide the scope of the appendix. Appendix **A** would contain requirements for the methods used in performing flight safety analysis as required by § 417.107(d) and subpart C of part 417. The methodologies contained in appendix **A** would represent acceptable means of satisfying the analysis performance requirements of subpart C and provide a standard against which any proposed altemative analysis approach would be measured. Appendix **A** would also identify the analysis products that a launch operator would be required to submit to the FAA in accordance with § 417.203(e).	No Comments.
Comments received regarding the October 2000 NPRM indicated that there was confusion as to who had to perform various flight safety analyses and regarding when the various analysis methodology requirements applied, in particular with regard to licensed launches from federal ranges. A417.3 would clarify that the requirements of appendix A would apply to a launch operator and the launch operator's flight safety analysis unless the launch operator demonstrated that an alternative approach provided an equivalent level of safety. If a federal launch range performed the launch operator's analysis, § 417.203(d) would apply. Proposed appendix **A** section A4 17.33 would apply to the flight of any unguided suborbital launch vehicle that used a wind weighting safety system. All other sections of appendix A would apply to the flight of any launch vehicle required to use a flight safety system in accordance with proposed § 417.107(a). For any alternative flight safety system approved by the FAA in accordance with 417.107(a)(3), the FAA would determine the applicability of appendix **A** during the licensing process.	No Comments.
Proposed section A417.5 references important requirements of the new proposed § 417.205 that a launch operator would need to know when satisfying the requirements of appendix A. These requirements are the general performance requirements for public **risk** management and the requirements for the compatibility of the input and output of dependent analyses	No Comments.
The remaining sections of appendix A do not contain any new requirements as compared to the Octobcr 2000 NPRM and current practice; however, the provisions of the Octobcr 2000 NPRM have been reorganized and in a number of cases, the requirements have been significantly streamlined in response to comments received on the NPRM and to provide greater	No Comments.

FAA SNPRM Preamble	Comment
consistency with current practice. Comments will be addressed in the final rule. Requirements that were in subpart C of part 417 of the October 2000 NPRM were streamlined where possible and moved to appendix A. For example, paragraph A417.7(a) references the new top level performance requirement, now in section 417.207. The rest of the material in A417.7 comes from section 417.205 of the original NPRM. The other sections in appendix A now follow this same approach. For each new performance requirement section in the revised part 417 subpart C, there is a section in appendix A. As another example, performance malfunction tum analysis requirements would now appear in § 417.211. The methodology requirements for calculating malfunction turn data and the requirements for analysis products that would apply to a launch operator's demonstration of compliance would now appear in A417.11. The flight hazard area analysis requirements that were in the original appendix A, have now been combined with the flight hazard area requirements that were in § 417.225 of the October 2000 NPRM and the combined requirements are now in A417.23. The FAA's goal is to have a single, all inclusive flight safety analysis appendix that contains detailed requirements necessary to demonstrate compliance with the flight safety analysis performance requirements that are now in subpart C of part 417.	
Proposcd section A417.7 contains trajectory analysis methodology requirements that were in § 417.205 of the October 2000 NPRM with some significant modifications. The NPRM would have allowed the use of annual or monthly composite wind profiles in a launch operator's trajectory analysis. Proposed A417.7(b) changes the proposed requirement to composite wind profiles for the month that a proposed launch will take place or winds that are as severe or more severe than the winds for the month that a proposed launch will take place. Annual winds may or may not represent worst case conditions. Use of annual winds in some cases can result in significant launch restrictions and in other cases may result in unsafe analysis results. Use of monthly wind profiles is current practice at both Air Force ranges and does not represent any increase in analysis effort. A launch operator would still be allowed to use "worst case winds" in a trajectory analysis.	No Comments.
The October 2000 NPRM would have required that the three-sigma trajectories be determined assuming a normal bivariate Gaussian distribution. The SNPRM contains changes that recognize that the distribution may in fact be something else. Paragraph A417.7(d) now proposes only that the trajectory analysis describe the distribution. The original requirements **for** a Gaussian distribution in the following paragraphs have been deleted and the	No Comments.

FAA SNPRM Preamble	Comment
paragraphs have been reworded to reflect the possibility of different distributions. These changes provide for greater flexibility and broader applicability of the requirements.	
The proposed requirements for a fuel-exhaustion trajectory in SNPRM paragraph A417.7(d)(3) have been streamlined as compared to § 417.205(d)(3) of the October 2000 NPRM. As indicated by comments received on the NPRM the subparagraphs under § 417.205(d)(3) of the NPRM were in some ways repetitive. The SNPRM contains no new fuel-exhaustion trajectory requirements. Proposed paragraph A417.7(d)(3) in the SNPRM has been reworded and the subparagraphs have been deleted to eliminate repetitiveness. The SNPRM clarifies that the requirements for a fuel-exhaustion trajectory only apply to launch vehicles with a last suborbital stage that will terminate thrust nominally without burning to fuel exhaustion.	No Comments.
Proposed A417.7(e) of the SNPRM contains requirements for a straight-up trajectory that remain unchanged from § 417.205(e) of the October 2000 NPRM.	No Comments.
Proposed A417.7(f) of the SNPRM contains significantly streamlined requirements from § 417.205(f) of the October 2000 NPRM. The NPRM would have directed the use of a root-sum-square analysis method or equivalent and provided some detailed requirements that would apply only to the root-sum-square method. The revised proposed requirements of A417.7(f) of the SNPRM provide a more performance oriented approach that recognizes that there is more than one acceptable analysis approach. A417.7(f) would still require the use of a six degree of freedom trajectory model; however, the paragraph would now contain performance requirements for how the model was used. The root-sum-square and Monte Carlo methods are now only referred to as examples of approaches that would satisfy the performance requirements. The detailed requirements proposed in the NPRM for performing a root-sum-square analysis have been deleted. Proposed section A417.7(e)(1) now requires that the analysis identify the distribution of each performance parameter rather than its standard deviation in recognition that the distribution may be other than normal.	No Comments.
A417.7(g) of the SNPRM contains requirements for trajectory analysis products from § 417.205(g) of the October 2000 NPRM with some streamlining and modifications to remain consistent with changes made to other paragraphs in section A417.7. Paragraph (g)(2) now requires a description of the distribution of each performance error as discussed earlier. Consistent with current practice, the proposed altitude intervals for the required wind profiles in paragraph (g)(3) have been changed from 1000 feet	No Comments.

FAA SNPRM Preamble	Comment
to 5000 feet, which results in fewer data points without any negative effect on the analysis. The last sentence in paragraph (g)(3) has been deleted in the SNPRM as redundant. Paragraph (g)(7) was modified in the SNPRM to combine the original paragraph § 417.205(g)(7) with paragraphs § 417.205 (g)(8) and (9) of the October 2000 NPRM. The SNPRM clarifies the proposed requirement for total thrust paragraph (g)(7)(xi) is total vacuum thrust. The requirements for dynamic pressure and Coriolis displacement proposed in paragraph § 417.205(g)(7)(xiii) and (xiv) of the NPRM have been deleted in the SNPRM as redundant because they can be determined from, or are incorporated into, other data that would be submitted.	
Proposed A417.9 of the SNPRM contains requirements for malfunction turn analysis from § 417.207 of the October 2000 NPKM with some streamlining and modifications made for clarity, flexibility, and consistency with current practice. Paragraph (b)(1) now clarifies that malfunction turn data must be provided for a duration of no less than 12 seconds or the product of 1.2 times the three-sigma upper bound time delay determined in accordance with A417.21, whichever is greater. New text in paragraph (b)(1) clarifies that these duration limits apply regardless of whether or not the vehicle would break up before the prescribed duration for the tum data. New text in paragraph (b)(2) states that the analysis must produce malfunction turn data for malfunctions initiated at intervals of no more than four seconds over the flight, instead of every trajectory time as proposed previously. The new text in paragraph (b)(2) is consistent with current 127-1 requirements. The definitions of the different types of malfunction turns that were in paragraph (b)(3) have been moved to paragraph (d). This change is purely an organizational change made to improve readability. Paragraph (b)(4) is revised to clarify that the first malfunction turn start time must correspond to lift-off. Paragraph (b)(4) is also revised to clarify that subsequent malfunction turns must be initiated at regular nominal trajectory time intervals not to exceed **the** greater of the three-sigma lower bound delay time or four seconds. Consistent with current Air Force requirements in EWR127-1, paragraph (b)(7) is modified to prescribe that gravity effect must be omitted from all malfunction turn data.	No Comments.
Proposed (d)(7)(ii) would require that if flying a trim turn is not possible even for a period of only a few seconds, the malfunction turn analysis would need only establish tumble turns. Otherwise, the malfunction tum analysis would be required to establish a series of trim turns, including the maximum-rate trim turn, and the family of tumble turns. During the **part** of launch vehicle tiight where the maximum trim angle of attack is smaii, tumble turns may	No Comments.

FAA SNPRM Preamble	Comment
result in the greatest malfunction turn angles. If the maximum trim angle of attack is large, trim turns may lead to higher malfiinction turn angles than tumble turns.	
In proposed (d)(7)(iii), where a launch operator would be required to establish the maximum turning capability of the launch vehicle, a launch operator would have to account for a launch vehicle that was unstable at low angles attack but stable at some higher angles of attack. If both large and small constant engine deflections of the launch vehicle resulted in tumbling, regardless of how small the deflection might be, the analysis would have to use the malfunction turn capabilities achieved at the stability angle of attack, assuming no upsetting thrust moment, in addition to the turns achieved by a tumbling vehicle. This situation arises because the stability at high angles of attack is insufficient to arrest the angular velocity, which is built up during the initial part of a tumble turn where the launch vehicle is unstable. Although the launch vehicle cannot arrive at this stability angle of attack as a rcsult of the constant engine deflection, there is some deflection behavior, such as the nozzle's rate of deflection, that will produce this result. If a launch operator did not elect to employ such a deflection program, the launch operator could simplify the analysis by assuming that the launch vehicle instantaneously rotated to the trim angle of attack and stabilized at this point. In such a case, tumble turn angles could be used during that part of launch vehicle flight for which the tumble turn envelope curve maintained a positive slope throughout the duration of the computation.	No Comments.
The phrase, "if thrust augmenting rocket motors are used on a launch vehicle," is deleted from paragraph (e)(4)(iii) because the launch operator would be required to submit vehicle orientation data in all cases. This modification is consistent with current EWR 127-1 requirements and necessary because the potential for non-symmetric induced velocities exists irrespective of the presence of thrust augmenting rocket motors.	No Comments.
Proposed section A417.11 of the SNPRM contains requirements for debris analysis taken from § 417.227 ofthe October 2000 NPRM with some streamlining and modifications made for clarity, to provide more flexibility, and to remain consistent with current practice. This section streamlines the October 2000 NPRM in that the same debris analysis requirements now apply to both intentionally jettisoned debris and debris resulting from launch vehicle break-up. Paragraph (c)(1) clarifies that a debris model must provide debris fragment data for the number of temporal segments sufficient to meet the requirements for smooth and continuous contours used to define hazard areas as required by A417.23. Paragraph (c)(8) and sub-paragraphs to (c)(3)	No Comments.

FAA SNPRM Preamble	Comment
are now consistent with the current Air Force requirements of EWR 127-1. Debris analysis requirements proposed by the October 2000 NPRM in paragraph (c)(9) were moved to the debris risk analysis section (A4 17.25) because computation of the effective casualty area for inert fragments depends on the path angle of the fragment trajectory at impact. Consistent with current Air Force requirements in EWR 127-1, paragraph (c)(10)(ii) now allows grouping of fragments with sub-sonic ballistic coefficients less than or equal to three within a class. Paragraph (c)(10)(iii) also proposes greater consistency with current Air Force requirements in EWR 127-1. Minor non-material changes were made to paragraph (d) and elsewhere to provide more clarity.	
Section A417.13 of the SNPRM contains requirements for flight safety limits analysis from § 4 17.2l l and § 4 17.213 of the October 2000 NPRM with some streamlining and modifications made for clarity, to provide more flexibility, and to remain consistent with current practice. As previously mentioned, the SNPRM eliminates the requirement for a separate flight control line analysis. The pertinent requirements to account for map and tracking errors that were part of the flight control lines analysis in the October 2000 NPRM are now included as part of the flight safety limits analysis. The October 2000 NPRM proposed that the flight safety limits "must ensure that the launch vehicle's debris impact dispersion does not extend beyond the flight control lines." In keeping with current practice at the federal ranges, paragraph (b) of the SNPRM expands and clarifies that for a flight termination at any time during launch vehicle flight, the flight safety limits would: (1) represent, but need to be limited to, the extent of the debris impact dispersion for all debris fragments with ballistic coefficient greater than or equal to three; and (2) ensure that the debris impact area on the Earth's surface that is bounded by the debris impact dispersion in the uprange, downrange and crossrange directions; does not extend to any populated or other protected area. Using flight safety limits to protect the public from debris with ballistic coefficient greater than or equal to three is consistent with current practice at the federal ranges. Any risk due to more wind sensitive debris with ballistic coefficients less than three are typically addressed using risk assessment. Paragraph (c) of the SNPRM presents the risk management options of employing flight safety limits that provide hazard isolation or defining flight safety limits that generally contain hazardous debris together with debris risk assessment to ensure the public risk criteria are satisfied.	No Comments.
Section A417.15 of the SNPRM contains requirements for straight-up time	No Comments.

FAA SNPRM Preamble	Comment
analysis from § 417.215 of the October 2000 NPRM with some streamlining. The SNPRM references sources of debris impact dispersion of A417.13(b)(4)(ii) through (xiii) instead of re-listing those. In addition, the SNPRM eliminates the requirement for a sample set of straight-up time calculations because a description of the methodology used will suffice.	
The SNPRM does not contain a section dedicated to wind analysis requirements such as § 417.217 of the October 2000 **NPRM.** Instead, wind analysis elements have been incorporated into those sections that involve wind analysis products.	No Comments.
Section A417.17 of the SNPRM contains requirements for a no-longer terminate gate analysis from §417.219 of the October 2000 NPRM with some streamlining. Paragraph (b)(4) was modified to clarify that the width of the gate must restrict a launch vehicle's normal trajectory ground trace. Because a "normal trajectory" means a trajectory within three-sigma of nominal with wind effects, the remainder of the (b)(4) was eliminated as redundant. Similarly, the definition of tracking representation was eliminated from (c)(1) since the SNPRM provides this definition in 5417.217.	No Comments.
Section A417.19 of the SNPRM contains requirements for the data loss flight time and no-longer terminate time analyses taken from § 417.221 of the October 2000 NPRM, with some streamlining and modifications made for clarity and to remain consistent with current practice. Paragraph (b) of the October 2000 NPRM was eliminated as redundant because the earliest destruct time is, in fact, the first data loss flight time. Paragraph A417.19(b) of the **SNPRM** modifies paragraph (c) of the October 2000 **NPRM** to provide requirements for the no-longer terminate time that are consistent with current practice. The SNPRM effectively replaces the term the no-longer endanger time in proposcd section A417.19 with the more generic term "no-longer terminate time" to be consistent with the performance requirements of proposed § 417.219. Proposed paragraph (b) adds the clarification that when determining the no-longer terminate time the analysis would account for a launch vehicle malfunction that would direct the vehicle toward the nearest flight safety limit or protected area following the same requirements proposed for determining the data loss flight times. Proposed paragraph (c) of the SNPRM modifies paragraph (d) of the October 2000 NPRM to provide the streamlined definition and requirements for data loss flight times that are consistent with current practice.	**No** Comments.
Section A417.21 of the SNPRM contains requirements for the time delay analysis from $417.223 of the October 2000 NPRM with some streamlining and modifications made tor clarity and to remain consistent with current	No Comments.

FAA SNPRM Preamble	Comment
practice.	
Section A4 17.23of the SNPRM contains requirements for flight hazard area analysis from §417.225 of the Octobcr 2000 NPRM with streamlining and substantial modifications made to enhance clarity, to provide greater flexibility, and to remain consistent with current practice. The SNPRM eliminates the reference to "safety clear zones" in paragraph (b) because no definition or requirements for such existed in the Octobcr 2000 NPRM with regard to flight safety analysis. However, the term was used in the proposed ground safety requirements of subpart E of the NPRM. In keeping with current practice, paragraph (b) was modified to present the options of employing a launch site flight hazard area that encompasses the flight safety limits when the hazard isolation option is employed in accordance A417.13(c) or encompasses all hazard areas established in accordance with paragraphs (d) through (i).	No Comments.
Proposed paragraph (d) of section A4 17.23 would now require that a debris impact hazard area account for the effects of impacting debris resulting from normal and malfunctioning launch vehicle flight, excluding toxic effects, and accounts for potential impact locations of all debris fragments. The October 2000 NPRM had required the debris hazard area to account for any toxic effects ofdebris, which is not consistent with current practice at thc Easter	No Comments.
n Range or Western Range. Paragraph (d)(1) and its sub-paragraphs would provide requirements that are consistent with current practice at the Eastern Range and Western Range for determination of an individual casualty contour. Specifically, the SNPRM clarifies that a debris hazard area must be bounded by an individual casualty contour that defines where the risk to an individual would exceed an expected casualty (E_C) criterion of 1×10^{-6} if one person were assumed to be in the open and inside the contour during launch vehicle flight. The SNPRM clarifies that an individual casualty contour would be determined using the blunt trauma and overpressure effects thresholds common to the Air Force and the FAA. Elements of the sub-paragraphs to (d) in the October 2000 NPRM are re-organized for greater clarity. Also, the sub-paragraphs to (d) are revised to provide greater flexibility by specifying performance level requirements. In sub-paragraph (d)(5), the SNPRM now requires only that the analysis must account for the type of vehicle breakup, either by thc flight termination system or by aerodynamic forces, eliminating the excess conservatism associated with the phrase "whichever results in the greater debris dispersion" that appeared in sub-paragraph (d)(4) of the Octobcr 2000 NPRM. In sub-paragraph (d)(6), the SNPRM now requires that the analysis use a probability of occurrence	No Comments.

FAA SNPRM Preamble	Comment
cqual to one for the planned debris fragmcnts produced by normal separation cvcnts during flight, consistent with current practice. This correction to the October 2000 NPRM provides positive public protection from planned jettison debris regardless of the probability of mission success.	
Proposed paragraph (e) in section A417.23 of the SNPRM contains modified requirements for the near-pad blast hazard area that are more consistent with current practice than those in the October 2000 NPRM. The paragraph (e) would require a hazard area analysis to dcfinc a blast overpressure hazard area as a circle centered at the launch point with a radius equal to the 1.O-psi overpressure distance produced by the equivalent TNT conimensurate with the explosive capability of the vehicle, in lieu of thc 3.0 psi overpressure level specified in the October 2000 NPRM. This modification is generally consistent with current practice, although overpressure levels used to define near-pad blast hazard areas for flight vary significantly between ranges. The Eastern Range uses an overpressure level that is more conservative than 1.0 psi. Also consistent with current practice, the paragraph would require the establishment of a minimum near-pad blast hazard area to provide protection from hazardous fragments potentially generated and propelled by an explosion. These modifications to paragraph (c) are not expected to produce more restrictive hazard areas because the overall flight hazard area must envelope the near-pad blast hazard area, the individual casualty contour, any ship-hit contours, and any aircraft-hit contour. Typically, a near-pad blast hazard area established to meet the proposed requirements would not extend beyond the individual casualty contour.	It is known that the characteristics of typical rocket propellant explosions can be significantly different from explosions of TNT. The FAA and Common Standards Working Group should initiate a scientific study to determine if the 'TNT equivalence' methodology currently used at federal ranges will produce realistic 1.O-psi overpressure radii for a variety of common liquid and solid propellant combinations.
Proposed paragraph (g) in section A4 17.23 of the SNPRM contains modified requirements for the flight hazard area ship-hit contours that are morc consistent with current practice and provide greater flexibility by specifying performance level requirements. Whereas the NPRM of October 2000 specified that the ship-hit contour need not account for debris with a ballistic coefficient less than three, the SNPRM requires that the ship hit use the blunt trauma and overpressure effects thresholds common to the Air Force and the FAA. As previously discussed, these thresholds provide a level of protection commensurate with current practice.	No Comments.
Proposed section A417.25 of the SNPRM contains requirements for debris risk requircmcnts from §417.227 of the October 2000 NPRM with some streamlining and modifications made for clarity, to provide more flexibility, and to remain consistent with current practice. Paragraph (b)(3) would be streamlined by replacing "planned launch vehicle events and breakup of a launch vehicle duc to activation of a flight termination system or spontaneous	No Comments.

FAA SNPRM Preamble	Comment
breakup due to a launch vehicle failure during launch vehicle flight" with "normal and malfunctioning launch vehicle flight." Whereas the NPRM of October 2000 indicated that the debris risk analysis would not need to account for debris with a ballistic coefficient less than three, the SNPRM specifies the that the debris risk analysis must use the blunt trauma and ovcrpressure effects thresholds common to the Air Force and the FAA.	
New text in paragraph (b)(4)(i) of section A417.25 clarifies the portion of trajectory time for which a debris risk analysis must account. The text, "planned flight events and from launch vehicle failure" is replaced with "normal and malfunctioning launch vehicle flight" in accordance with discussions with the Common Standards Working Group. Modifications in paragraph (b)(4)(ii) clarify that the factors accounted for in the dispersion for each debris class include the variance produced by break-up imparted velocities and the variance produced by aerodynamic properties for each debris class. Variance in the impact dispersion due to aerodynamic properties includes the effects of lift and drag, whereas the NPRM inadvertently omitted the influence of lift. Paragraph (b)(4)(iii) is streamlined to delete redundant text. The phrase, "performs a survivability analysis and" is deleted from the second sentence of this paragraph to allow an assumption of 100% survivability to substitute for a survivability analysis.	To define the 3-sigma variation in fragment parameters as required by this section would require an extensive program of destroying a statistically significant number of flight configuration vehicles and carefully measuring and recording the variation in ballistic coefficient, etc., for each fragment. This is commercially impractical. For an analyst to speculate at these 3-sigma variations using 'engineering judgement' cannot provide risk analysis data that is any more accurate than an analysis that uses only nominal value: for the debris characteristics. The FAA should remove the requirement for these 3-sigma variations on fragment properties.
Paragraph (b)(8) of section A417.25 is modified to require the use the blunt trauma and overpressure effects thresholds common to the Air Force and the FAA. New text is added as (b)(8)(i) and (b)(8)(ii) to provide more flexibility in casualty area analysis for inert debris fragments. The SNPRM proposes a two-tier approach to the casualty area estimates that allows a simple and conservative estimate (that the effective casualty area equals seven times the maximum projected area of the fragment) to substitute for an analysis of the effective casualty area for each inert debris fragment that accounts for bounce, skip, slide, and splatter effects based on the path angle of the fragment trajectory at impact among other influences.	No Comments.
The first sentence of pardgraph (b)(9) clarifies that "traditional" population growth rate equations are exponential in nature. The second sentence in this paragraph is deleted as unnecessarily prescriptive and inflexible. The population model requirements are streamlined and clarified to define population centers that are similar enough to be described and treated as a single average set of characteristics without degrading the accuracy of the debris risk estimate.	The FAA should work with the federal ranges and the Common Standards Working Group to develop world population models that arc consistent and made available for all launch operators to use. The 45th Space Wing has already done this for Africa.
The second sentence in paragraph (b)(10)(iii) of section A417.25 is modified for clarity by deleting the word "census." Population density information	No Comments.

FAA SNPRM Preamble	Comment
may come from other sources. Paragraph (c)(3) was reorganized and modified for clarity to include subparagraphs (i), (ii), and (iii). Paragraph (c)(3)(i) states, "Flies within normal limits until some malfunction causes spontaneous breakup or results in a commanded flight termination." Paragraph (c)(3)(ii) is modified to read, "Experiences malfunction turns." This new failure scenario text is consistent with current EWR 127-1 requirements. Paragraph (c)(3)(iii) is added to read, "Flight safety system fails to function." The word "cell" in Paragraph (c)(4) is replaced with "center" to reflect current practice. New text is added to account for a population model containing a description of the shelter characteristics within the population center. The new text in paragraph (c)(4) identifies a population characteristic currently used in Range Safety population models.	
The SNPRM proposes minor modifications to paragraph (c) form completeness, to enhance clarity, and to require that the debris risk analysis products are consistent with current practice as well as the proposed requirements. In sub-paragraph (7)(i), the SNPRM clarifies that the debris analysis products must describe the propellant composition, instead of its ingredients. This correction indicates that the relevant information is the product of propellant formulation process. Whereas the October 2000 NPRM required simply that the debris analysis products must include a description of the "thrust profile," the SNPRM clarifies this requirement by specifying the "vacuum thrust profile" in sub-paragraph (7)(ii). Because the SNPRM specifies that the "vacuum thrust profile" is used to describe the "thrust profile," the FAA proposes to add sub-paragraph (7)(viii) to require description of the corresponding nozzle entrance and exit areas for completeness. Section A417.229 of the SNPRM contains modified requirements based on §417.231 of the October 2000 NPRM with substantial streamlining and modifications made for clarity, to provide more flexibility, and to remain consistent with current practice. Paragraph (a) combines paragraphs (a) and (c) from §417.231 of the October 2000 NPRM. Paragraph (a) now states that a flight safety analysis must account for distant focus overpressure and any overpressure enhancement to establish the potential for broken windows due to peak incident overpressures below 1.0 psi and related casualties due to falling or projected glass shards. Paragraph (a) also provides the option to perform a risk analysis to assess the potential for casualties due to window breakage consistent with the updated public risk criteria regarding blast risk. To provide greater consistency with current practice, paragraph (a) clarifies that a flight safety analysis must account for any potential source of tar-tieid overpressure that mav cause window breakage, not exclusivelv	No Comments.

FAA SNPRM Preamble	Comment
distant focus overpressure from debris impacts. Given the proposed 1.0 psi threshold for debris risk analysis, the **FAA** and Air Force concluded that the proposed far-field blast overpressure analysis must account for any potential source of far-field overprcssure to ensure adequate public protection from potential window breakage hazards. Past experience at the ER and WR demonstrates that debris impacts are the overwhelmingly dominant source of public due risk due to far field overpressure (peak incident overpressures below I.0 psi). Paragraph **(b)** now provides performance level requirements that apply to both hazard analysis and probabilistic far-field blast overpressure analyses, in lieu of the prescriptive requirements put forth in the October 2000 NPRM.	
Section A417.3 1 of the SNPRM contains requirements for collision avoidance analysis taken from $417.233 of the October 2000 NPRM with some streamlining and modifications made for clarity. The terms "licensee" and "license applicant" in A4 17.3 I are now renamed "launch operator" to reflect similar terminology used throughout other sections. The second sentence in paragraph (b)(3) now states, "If an updated conjunction on launch assessment is needed due to a launch delay, a launch operator must submit the request to United States Space Command at least I2 hours prior to the beginning of the new launch window." This clarifies the agency responsible for receiving collision avoidance analysis requests and the lead-time for such requests. The launch assessment worksheet, figure **A4** 17.3 1 1., in paragraph (c) is no longer necessary. All data requirements are described in the following text. Removal of the figure streamlines this section and eliminates the requirement to revise this section when the assessment worksheet format changes. The second sentence in paragraph (c)(5) originally read, "The term 'vector at injection' is used *to* identify the position and velocity vectors after the thrust for a segment has ended." This is now changcd to read, "The term 'vector at injection' is used to identify the position and velocity of all orbital or suborbital segments after the thrust for a segment has ended." This is more technically correct. Paragraph (c)(5) is streamlined by deleting the third sentence. This sentence is unnecessary since it provides a previous definition to a term that is no longer used. Position and velocity information in paragraph (c)(5)(ii) is modified for the purposes of clarity to read, "The position coordinates in the EFG coordinate system measured in kilometers and the EFG components measured in kilometers per second, of each launch vehicle stage or payload after any burnout, jettison, or deployment."	No Comments.

FAA SNPRM Preamble	Comment
Appendixes B through I of Dart 417	
The only changes that this SNPRM makes to appendixes B though I of part 417 involve references made to sections of proposed subpart C of part 417. This SNPRM modifies and reorganizes proposed subpart C of part 417. As a result a number of refcrences made in proposed appendixes B through I of part 417 to sections in subpart C of part 417 must be changed accordingly. The necessary reference changes are identified in this SNPRM.	
VI. Procedural Matters	
Paperwork Reduction Act	
As required by the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 et seq., the Federal Aviation Administration has reviewed the information collection requirements of this supplemental notice of proposed rulemaking. The FAA has determined that this supplemental notice of proposed rulemaking does not alter the information collection requirements of the notice of proposed rulemaking issued October 25, 2000. With that notice of proposed rulemaking, the FAA determined that there would be no additional burden to respondents over and above that which the Office of Management and Budget has already approved under the existing rule titled, "Commercial Space Transportation Licensing Regulations" (OMB control number 2120-0608). Under the existing rule, the FAA considers license applications to launch from non-federal sites on a case-by-case basis. In conducting a case-by-case review, the FAA gives due consideration to current practices in space transportation, generally involving launches from federal sites. Accordingly, the FAA believes that, under the proposals of the NPRM and this SNPRM, there would be no additional information collection not already included in the previously approved information collection activity. This rule would eliminate the case-by-case review, thereby streamlining the licensing process, and would not place any additional burden on the resnondent.	

FAA SNPRM	Suggested Change or Comment	Rationale
Part 417 – Launch Safety	**Alternate 1**	
8. Revise § 417.1 as proposed to be revised at 65 FR 63977 to read as follows:		
Subpart A—General		
§ 417.1 Scope and Applicability.		
(a) General. This part prescribes the responsibilities of a launch operator conducting a licensed launch of an expendable launch vehicle and the requirements with which a licensed launch operator must comply to maintain a license and conduct a launch.		
(1) The safety requirements of this part apply to all licensed launches of expendable launch vehicles, except for a launch from a federal launch site that meets one of the conditions of paragraph (b).		
(2) All the administrative requirements of this part for submitting material to the FAA apply to all licensed launches from a non-federal launch site. For a licensed launch from a federal launch range, an administrative requirement of this part does not apply if the FAA, through its baseline assessment of the range, finds that the range satisfies the requirement. For a licensed launch from a federal range where the range does not satisfy one or more of the requirements of part 417, the FAA will identify, during the licensing process, the administrative requirements that the launch operator must meet.	2) All the administrative requirements of this part for submitting material to the FAA apply to all licensed launches from a non-federal launch site. For a licensed launch from a federal launch range, an administrative requirement of this part does not apply if the FAA, through its baseline assessment of the range, finds that the range satisfies the requirement. For a licensed launch from a federal range where the range docs not satisfy one or more of the requirements of part 417, the FAA will independently work with the Air Force to reconcile the differences without impacting the users. Comment: Another alternative is for the FAA to publish the baseline in the regulation. If the FAA or the Air Force chooses to change the baseline	Launch operators at federal ranges cannot afford to comply with two sets of safety requirements. Two safety requirement documents, however close they may be claimed to be, results in the imposition of the dual requirements, dual flow down to all design document, safety assessment and compliance to dual requirements. This approach is redundant, impacting users significantly in cost, schedule and diversion of critical manpower with no improvement in safety. The suggested change will ensure imposition of only Air Force requirements at the federal ranges and at the same time provides an opportunity for FAA to work with Air Force to develop their requirements without impacting the range users.

FAA SNPRM	Suggested Change or Comment	Rationale
	the FAA can publish in the regulation, an amended baseline. This process will ensure enough advance notification to the launch operator to comply with changes.	
(3) Requirements for preparing a license application to conduct a launch, including all related policy, safety and environmental reviews and payload determinations, are contained in parts 413 and 415.		
(b) Federal launch range meets intent certifications, waivers, and noncompliances due to grandfathering.		
(1) If a launch operator has a license from the FAA to launch from a federal launch range as of the effective date of this part and, for a specific requirement of this part and launch:	If a launch operator has a license from the FAA to launch from a federal launch range as of the effective date of this part or intends to apply for a license at any future date	Suggested change will remove association to this part and permits continuation of grandfathering policy at the federal ranges.
(i) If the launch operator employs an alternative to the requirement for which the federal range has granted a written meets intent certification on or before the [EFFECTIVE DATE OF] this part, the launch operator need not demonstrate to the FAA that its alternative provides an equivalent level of safety; or	If the launch operator employs an alternative to the requirement for which the federal range has given launch approval ~~or a written meets intent certification on or before the [EFFECTIVE DATE OF] this part,~~ the launch operator need not demonstrate to the FAA that its alternative provides an equivalent level of safety; or	Suggested change removes association of an effective date with grandfathering process. Also removes the need for mandated written paperwork burden.
(ii) If the launch operator has, on or before the [EFFECTIVE DATE OF] this part, a written waiver from the federal launch range or a noncompliance that satisfies the federal launch range's grandfathering criteria, the requirement of this part does not apply to the launch.	If the launch operator has~~, on or before the [EFFECTIVE DATE OF] this part~~, a ~~written~~ waiver or flight plan approval from the federal launch range or a noncompliance that satisfies the federal launch range's grandfathering criteria, the requirement of this part does not apply to the launch.	Suggested change removes association of an effective date with grandfathering process. Also removes the need for mandated written paperwork burden.
(2) Even if a launch operator satisfies paragraph (b)(1) of this section for a specific requirement of this part, the launch operator must bring its launch and launch vehicle, including components, systems, and subsystems, into compliance with the requirement. whenever one or more of the following conditions occurs:	Even if a launch operator satisfies paragraph (b)(1) of this section for a specific requirement of this part, the launch operator ~~must~~ may be required to bring its launch and launch vehicle, including affected components, systems, and subsystems, into comoliance with the reauirement. whenever one or more of the following conditions occurs:	Suggested change avoids imposition of dual requirements at the federal ranges. This will also ensure Air Force independence in grandfathering decisions.

FAA SNPRM	Suggested Change or Comment	Rationale
	Note: At Fedcral Ranges, users are subject to the conditions in the applicable Air Force range rcquircments.	
(i) The launch operator makes modifications that affect the launch vehicle's operation or safety characteristics;	The launch operator makes modifications that affect the launch vehicle's operation or safety characteristics to such an extent that granting the waiver will lead to unacceptable safety consequence;	Modifications are very subjective. Even if a modification affects safety characteristics, one cannot eliminate a need for grandfathering. The decision should be based on the severity in the conseauence of nrandfatherinn.
(ii) The launch operator uses the launch vehicle, component, system, or subsystem in a new application;	The launch operator uses the launch vehicle, component, system, or subsystem in a new application and granting the waiver will lead to unacceptable safcty consequence;	This is an important aspect of the current grandfathering approach. If a stage or system was acceptable in the past with waivers, grandfathering should be permitted if there is no unacceptable safety consequence.
(iii) The FAA or the launch operator determines that a previously unforeseen or newly discovered safety hazard exists that is a source of significant risk to public safety; or		
(iv) The federal range previously accepted a component, system, or subsystem, but, at that time, did not identify a noncompliance to a federal range requirement.	The federal range previously accepted a component, system, or subsystem, but, at that time, did not identify a noncompliance to a federal range requirement. In addition, a review with Federal Ranges indicates that such a non-compliance would not have been approved even if it was identified at that time and would lead to unacceptable safety consequence	Even at non-federal rangcs, a non-compliance must be evaluated on its own merit whether it was identified earlier or not. Compliance to new requirements should be desired only if it can lead to an unacceptable safety consequence.
	Add the following new provision: (c) *Equivalent Level of Safety Finding.* If a launch operator has made a an equivalent level of safety of any altemate analysis or method of analysis or any altemate flight safety system or subsystem as the basis for obtaining or maintaining a launch operator license, the launch operator shall not be required to perform another demonstration with respect to such analysis, method, or flight safety system or subsystem unless one or more of the following conditions occurs: (I) The launch operator makes modifications that aftect launch vehicle operations	**A** new demonstration should not be required as long as the conditions have not changed. Compare SNPRM § 417.203(a), which allows a launch operator to "rely on an earlier analysis."

FAA SNPRM	Suggested Change or Comment	Rationale
	or safety characteristics in a way that invalidates the demonstration; (2) The launch operator uses the launch vehicle, component, system, or subsystem in a new application in a way that invalidates the demonstration; or (3) The FAA or launch operator determines that a previously unforeseen or newly discovered safety hazard exists that is a source of significant risk to public safety.	
9. Amend proposed § 417.3 as proposed to be revised at 65 FR 63977 by removing the definition of serious injury; and adding the following definitions in alphabetical order:		
§ 417.3 Definitions.	Suggest adding 'Grandfathering' to the definition list.	Grandfathering needs to be defined to avoid confusion.
Equivalent level of safety means an "approximately equal" level of safety. An equivalent level of safety may involve a change to the level of expected risk that is not statistically or mathematically significant as determined by qualitative or quantitative risk analysis.	Equivalent level of safety means an "approximately equal" level of safety. An equivalent level of safety may involve a change to the level of expected risk that is not ~~statistically or mathematically~~ significant. ~~as determined by qualitative or quantitative risk analysis~~ Alternate definition: Equivalent level of safety means "substantially the same level of safety	Suggested change simplifies the definition and keeps it flexible. The FAA's proposed definition is too constraining. If the "change to the level of expected risk" for any alternate analysis or method cannot be "mathematically significant," then can the risk be at all different? "Mathematical" is defined as "rigorously precise." The Federal Aviation Regulations, while using the language "equivalent level of safety" in many instances, do not define the phrase. Nor do the FAA's launch site licensing regulations. The "equivalent level of safety" definition conflicts with NPRM § 417.107(a)(3)(i) which provides that a launch operator using an alternate flight safety system must "demonstrate that the launch presents significantly less public risk . . . ." If "equivalent level of safety" is defined in terms of risk, how can a launch operator having to meet this definition at the same time be reouired to

FAA SNPRM	Suggested Change or Comment	Rationale
		show significantly less risk? If the FAA introduces a definition of "equivalent level of safety," consistency must be ensured throughout the NPRM/SNPRM. See, e.g., NPRM § 417.107(a)(3), which speaks about a "level of safety that is equivalent. . . ."
Explosive debris means solid propellant fragments or other pieces of a launch vehicle or payload that result from breakup of the launch vehicle during flight and that explode upon impact with the Earth's surface and cause overpressure.		
Meets intent certification means a decision by a federal launch range to accept a substitute means of satisfying a safety requirement where the substitute provides an equivalent level of safety to that of the original requirement.		
Normal flight means the flight of a properly pcrforming launch vchiclc whose real-time instantaneous impact point does not deviate from the nominal instantaneous impact point by more than the sum of the wind effects and the three-sigma guidance and performance deviations in the uprange, downrange, left-crossrange, or right-crossrange directions.		
Normal trajectory means a trajectory that describes normal flight.		
Risk means a measure that accounts for both the probability of occurrence of a hazardous event and the consequence of that event to persons or property.		
Waiver means a decision that allows a launch operator to continue with a launch despite not satisfying a specific safety requirement and where the launch operator is not able to demonstrate an equivalent level of safety. A waiver may apply	Waiver means a decision that allows a launch operator to continue with a launch despite not satisfying a specific safety requirement and where the launch operator is not able to demonstrate an equivalent level of safety. A waiver may apply	Suggested change simplifies the definition and keeps it flexible. The FAA's proposed use of the "waiver" definition is not clear. Waivers are permitted by CSLA and FAA regulations, 14 C.F.R. § 404.5(b).

FAA SNPRM	Suggested Change or Comment	Rationale
where a failure to satisfy a safety rcquircmcnt involves a statistically or mathematically significant increase in cxpectcd risk as determined through qualitative or quantitative risk analysis, and where the activity may or may not exceed the public risk criteria.	where a failure to satisfy a safety requirement involves a ~~statistically or mathematically~~ significant increase in expected risk as determined through qualitative or quantitative risk analysis, and where the activity may or may not exceed the public risk criteria.	However, the SNPRM preamble indicates that the FAA will be reluctant ever to grant a waiver. The FAA states: "Preferably, a launch operator subject to FAA regulations would demonstrate an equivalent level of safety to obtain relief. . . ." SNPRM at p. 49477. The FAA further states that its "focus on the public safety aspects of licensed launches restricts consideration of mission objectives, including cost or schedule considerations, as justification for approval." ***Id.*** Under what conditions would the FAA grant a waiver?
10. Amend § 4 17.107 as proposed to be revised at 65 FR 6398 1 by revising paragraph (b); redesignating paragraphs (c) through **(f)** as paragraphs (e) through (h), respectively; adding new paragraphs (c) and (d); and revising newly redesignated paragraphs (e) and **(f)** to read as follows:		

FAA SNPRM	Suggested Change or Comment	Rationale
Part 417 – Launch Safety	**Alternate 2**	
8. Revise § 417.1 as proposed to be revised at 65 FR 63977 to read as follows:		
Subpart A—General		
§ 417.1 Scope and Applicability.	If the Office were to add a provision permitting the Office to accept federal range safety authority determination of launch operator compliance to the range's established safety rules, it would offer the launch operator opportunity to demonstrate an cquivalcnt level of safety methodology WITHOUT having to change established compliance hardware processes. This is, in fact, the exact same methodology used currently by the Office today. To be effective, the Office has to accept the federal range safety authority determination WITHOUT requiring the launch operator to provide additional certifications, documentation, analyses or other duplicative products as a condition to using the methodology. This is, again, the exact same methodology used currently by the Office today. Some of the changes proposed below attempt to implement this concept.	This proposal minimizes the change to the existing industry in terms of requirements definition, requirements verification, analysis , documentation, and the overall federal range process. Additional discussion is contained below.
(a) General. This part prescribes the responsibilities of a launch operator conducting a licensed launch of an expendable launch vehicle and the requirements with which a licensed launch operator must comply to maintain a license and conduct a launch.		
(1) The safety requirements of this part apply to all licensed launches of expendable launch vehicles, except for a launch from a federal launch site that meets one of the conditions of paragraph (b).	Revise paragraph to state "A licensed launch of an expendablc launch vehicle which utilizes a federal range safety organization meets thc intent of Part 417 provided an acceptable FAA baseline assessment of the range is in effect. If this is thc case, the range user's compliance with applicable federal rangc regulations is accentahle to the FAA. thc federal range safetv process remains	This provides the same level of public safety that exists currently. Also this implementation is transparent to the launch provider and the vast majority of thc existing launch industry. This transparency will minimize the overall cost impact. This also provides via the baseline assessment process a vehicle for the FAA to evaluate the performance of the range. and

FAA SNPRM	Suggested Change or Comment	Rationale
	unchanged, and no demonstration to the FAA of compliance to part 417 requirements is required. For a licensed launch from a federal range where the FAA baseline assessment identifies discrepancies, the FAA will identify the Part 417 requirements that the launch operator must meet to alleviate the discrepancies."	implement changes to the range safety process.
(2) All the administrative requirements of this part for submitting material to the FAA apply to all licensed launches from a non-federal launch site. For a licensed launch from a federal launch range, an administrative requirement of this part does not apply if the FAA, through its baseline assessment of the range, finds that the range satisfies the requirement. For a licensed launch from a federal range where the range does not satisfy one or more of the requirements of part 417, the FAA will identify, during the licensing process, the administrative requirements that the launch operator must meet.		
(3) Requirements for preparing a license application to conduct a launch, including all related policy, safety and environmental reviews and payload determinations, are contained in parts 413 and 415.		
(b) Federal launch range meets intent certifications, waivers, and noncompliances due to grandfathering.	Dclctc bascd upon revision to paragraph 417.1 (a)(1) above.	Proposcd revision supercedes para (b) and all sub paragraphs.
(1) If a launch operator has a license from the FAA to launch from a federal launch range as of the effective date of this part and, for a specific reauircmcnt of this Dart and launch:	Delete based upon revision to paragraph 417.1 (a)(1) above.	Proposed revision supercedes para (b) and all sub paragraphs.
(i) If the launch operator employs an altemative to the requirement for which the federal range has granted a written meets intent certification on or before the [EFFECTIVE DATE OF] this part, the launch operator need not demonstrate to the FAA that its alternative provides an equivalent level of safety; or	Delete based upon revision to paragraph 417.1 (a)(1) above.	Proposed revision supercedes para (b) and all sub paragraphs.

FAA SNPRM	Suggested Change or Comment	Rationale
(ii) If the launch operator has, on or before the [EFFECTIVE DATE OF] this part, a written waiver from the federal launch range or a noncompliance that satisfies the federal launch range's grandfathering criteria, the requirement of this part does not apply to the launch.	Delete based upon revision to paragraph 417.1 (a)(1) above.	Proposed revision supercedes para (b) and all sub paragraphs.
(2) Even if a launch operator satisfies paragraph (b)(1) of this section for a specific requirement of this part, the launch operator must bring its launch and launch vehicle, including components, systems, and subsystems, into compliance with the requirement, whenever one or more of the following conditions occurs:	Delete based upon revision to paragraph 417.1 (a)(1) above.	Proposed revision supercedes para (b) and all sub paragraphs.
(i) The launch operator makes modifications that affect the launch vehicle's operation or safety characteristics;	Delete based upon revision to paragraph 417.1 (a)(1) above.	Proposed revision supercedes para (b) and all sub paragraphs.
(ii) The launch operator uses the launch vehicle, component, system, or subsystem in a new application;	Delete based upon revision to paragraph 417.1 (a)(1) above.	Proposed revision supercedes para (b) and all sub paragraphs.
(iii) The FAA or the launch operator determines that a previously unforeseen or newly discovered safety hazard exists that is a source of significant risk to public safety; or	Delete based upon revision to paragraph 417.1 (a)(1) above.	Proposed revision supercedes para (b) and all sub paragraphs.
(iv) The federal range previously accepted a component, system, or subsystem, but, at that time, did not identify a noncompliance to a federal range requirement.	Delete based upon revision to paragraph 417.1 (a)(1) above.	Proposed revision supercedes para (b) and all sub paragraphs.
9. Amend proposed § 417.3 as proposed to be revised at 65 FR 63977 by removing the definition of serious injury; and adding the following definitions in alphabetical order:		
§ 417.3 Definitions.		
Equivalent level of safety means an "approximately equal" level of safety. An equivalent level of safety may involve a change to the level of expected risk that is not statistically or mathematically significant as determined by qualitative or quantitative risk analysis.		

FAA SNPRM	Suggested Change or Comment	Rationale
Explosive debris means solid propellant fragments or other pieces of a launch vehicle or payload that result from breakup of the launch vehicle during flight and that explode upon impact with the Earth's surface and cause overpressure.		
Mccts intent certification means a decision by a federal launch range to accept a substitute means of satisfying a safety requirement where the substitute provides an equivalent level of safety to that of the original requirement.		
Normal flight means the flight of a properly pcrforming launch vehicle whose real-time instantancous impact point does not deviate from the nominal instantaneous impact point by more than the sum of the wind cffccts and the three-sigma guidance and performance deviations in the uprange, downrange, left-crossrangc, or right-crossrange directions.		
Normal trajectory means a trajectory that describes normal flight.		
Risk means a measure that accounts for both the probability of occurrence of a hazardous event and the consequence of that event to persons or property.		
Waiver means a decision that allows a launch operator to continue with a launch despite not satisfying a spccific safety requirement and where the launch operator is not able to demonstrate an equivalent level of safety. A waiver may apply where a failure to satisfy a safety requirement involves a statistically or mathematically significant increase in expected risk as determined through qualitative or quantitative risk analysis, and where the activity may or may not exceed the public risk criteria. 10. Amend § 417.107 as proposed to be		

FAA SNPRM	Suggested Change or Comment	Rationale
redesignating paragraphs (c) through (f) as paragraphs (e) through (h), respectively; adding new paragraphs (c) and (d); and revising newly redesignated paragraphs (e) and (f) to read as follows:		

FAA SNPRM	Suggested Change or Comment	Rationale
Subpart B – Launch Safety Requirements		
§ 417.107 Flight safety.		
* * * * * * *		
(b) Public risk criteria. A launch operator may initiate the flight of a launch vehicle only if flight safety analysis performed under paragraph (f) of this section demonstrates that any risk to the public satisfies the following public risk criteria:		
(1) A launch operator may initiate the flight of a launch vehicle only if the risk associated with the total flight to all members of the public, excluding persons in waterborne vessels and aircraft, does not exceed an expected average number of 0.00003 casualties ($E_C \leq 30 \times 10^{-6}$) from impacting inert and impacting explosive debris, $E_C \leq 30 \times 10^{-6}$ for toxic release, and $E_C \leq 30 \times 10^{-6}$ for far field blast overpressure. The FAA will determine whether to approve public risk due to any other hazard associated with the proposed flight of a launch vehicle on a case-by-case basis. The E_C criterion for each hazard applies to each launch from lift-off through orbital insertion, including each planned impact, for an orbital launch, and through final impact for a suborbital launch.	Prior to establishing any Final Rule, the Industry requests a copy of Eastern Range Aggregate Risk Study, RTI Int'l (Oct. 2, 2001), as well as a briefing from the organizations contributing to the study, to discuss the study and the proposed toxic release Ec limit in more detail. Will the **FAA** ever consider a waiver to any individual Ec mission risk cap'? Note that EWR 127-1 defines two more risk levels: 1) 30×10^{-6} to 300×10^{-6} Requires deviation or waiver from the Range Commander to fly. 2) $>300 \times 10^{-6}$ which is unacceptable. 127-1 states that based on national need and the approval of the Range Commander / Wing Commander's approval, launches may be permitted using a predicted risk above **30 x** 10^{-6}. Recommend that the Final Rule adopt language that will allow the risk level values to be treated as guidelines to permit needed	The Industry needs more information to understand the proposed changes and to determine if there are any impacts to launch availability that are not obvious. The Industry also needs to know if the individual Ec mission risk caps are inviolate under any circumstances. If so, business opportunities for missions overflying populated areas such as Europe may be jeopardized. There should be a stated provision allowing exceedance of 30×10^{6}. The upper limit should not automatically stop a flight without review and, therefore, needs to be treated as a guideline rather than a limit..

FAA SNPRM	Suggested Change or Comment	Rationale
	flexibility.	
(2) A launch operator may initiate flight only if the risk to any individual member of the public does not exceed a casualty expectation (E_c) of 0.000001 per launch ($E_c \leq 1 \times 10^{-6}$) for each hazard, excluding persons in waterborne vessels and aircraft.	As long as the Federal Ranges currently meet the specified criteria and there is no impact to launch availability for current and proposed vehicle configurations, this Ec limit is not a problem. Recommend Final Rule adopt language treating the risk level value as "launch risk guidance" to allow flexibility.	The value lacks "focused scientific study" basis. Therefore, it would be prudent to treat the value as a guideline until such time as the necessary study can be performed to establish the required value.
(3) A launch operator may initiate flight only if the probability of debris impact to all water-borne vessels (P_{iv}) that are not operated in direct support of the launch does not exceed 0.00001 ($P_{iv} \leq 1 \times 10^{-5}$) in each debris impact hazard area of § 417.223.	As long as the Federal Ranges currently meet the specified probability of debris criteria and there is no impact to launch availability for current and proposcd vehicle configurations, this is not a problem. Recommend Final Rule adopt language treating the risk level value as "launch risk guidance" to allow flexibility.	The value lacks "focused scientific study" basis. Therefore, it would be prudent to treat the value as a guideline until such time as the necessary study can be performed to establish the required value.
(4) A launch operator may initiate flight only if the probability of debris impact to any individual aircraft (P_{ia}) not operated in direct support of the launch does not exceed 0.00000001 ($P_{ia} \leq 1 \times 10^{-8}$) in each debris impact hazard area of § 417.223.	As long as the Federal Ranges currently meet the specified probability of debris criteria and there is no impact to launch availability for current and proposed vehicle configurations, this is not a problem. Recommend Final Rule adopt language treating the risk level value as "launch risk guidance" to allow flexibility.	The value lacks "focused scientific study" basis. Therefore, it would be prudent to treat the value as a guideline until such time as the necessary study can be performed to establish the required value.
(c) Debris thresholds. A launch operator's flight safety analysis, performed as required by paragraph (f) of this section, must account for any inert debris impact with a mean expected kinetic energy at impact greater than or equal to 11 ft-lbs and, except for the far field blast overpressure effects analysis of § 417.229, a peak incident overpressure greater than or equal to 1.0 psi due to any explosive debris impact.	If the Federal Ranges are currently meeting the debris threshold criteria, this is not a launch availability problem for the Industry. The analysis is not currently done for Sea Launch, and the requirement is more restrictive than the NPRM. Recommend that the detail on how to perform the analyses and the values to be used in the analyses De removed from the Final Rule and	Prescribing this level of detail in the rule makes it less flexible and does not permit the evolution of the analyses/values required at this time. These data

FAA SNPRM	Suggested Change or Comment	Rationale
	issued scparatcly as an Advisory Circular or some similar means.	would bc best addressed as part of the SNPRM suggested "focused scientific study" before adoption into **law.**
(1) When using the 11ft-lb threshold **to** determine potential casualties due to blunt trauma from inert debris impacts, the analysis must:		
(i) Incorporate a probabilistic model that accounts for the probability of casualty due to any debris expected to impact with kinetic energy of 11 ft-lbs or greater and satisfies paragraph (d) of this section; or	Launch operators cannot afford to develop, utilize, and maintain probabilistic human vulnerability models due to cost, schedule, lack of statistical input data, and lack of experience with such models. Launch operators also cannot continuously afford the expense of subcontracting such work. These models should be the responsibility of the FAA and/or the Federal Ranges. The analysis is not currently done for Sea Launch, and the requirement is more restrictive than the NPRM.	
(ii) Count cach expected impact with kinetic energy of 11 ft-lbs or greater to a person as a casualty.	Have all the vehicle debris models been analyzed to determine if the proposed change will decrease launch availability for any vehicle configuration'?If so, thcn (1) launch operators request a bricfing on the analyses performed; if not, thcn (2) such analyses need to bc donc. In either case, no Final Rule should bc adopted prior to (1) or (2). What happened to flexibility and the use of alternate methods?	
(2) When applying the 1.O-psi threshold to determine potential casualties due to ovcrpressure effects, the analysis must:	Have all the vehicle configurations been analyzed to determine if the proposed change will decrease launch availability for any vehicle configuration? If so, then (1) the launch operators request a briefing on the analyses performed; if not, then (2) such analyses need to bc donc. In either ease, no Final Rule should be adopted prior to (1) or (2).	

FAA SNPRM	Suggested Change or Comment	Rationale
(i) Incorporate a probabilistic model that accounts for the probability of casualty due to any blast overpressures of 1.O-psi or greater and satisfies paragraph (d) of this section; or	Launch operators cannot afford to develop, utilize, and maintain probabilistic human vulnerability models due to cost, schedule, lack of statistical input data, and lack of experience with such models. Launch operators also cannot continuously afford the expense of subcontracting such work. These models should be the responsibility of the FAA and/or the Federal Ranges. The analysis is not currently done for Sea Launch, and the requirement is more restrictive than the NPKM.	
(ii) Count each person within the 1.O-psi overpressure radius of the source explosion as a casualty. When using this approach, the analysis must compute the peak incident overpressure using the Kingery-Bulmash relationship and may not take into account sheltering, reflections, or atmospheric effects. For persons located in buildings, the analysis must compute the peak incident overpressure for the shortest distance between the building and the blast source. The analysis must count each person located anywhere in a building subjected to peak incident overpressure equal to or greater than 1.0 psi as a casualty.		
(3) The analysis must account for any inert debris impact with a mean expected kinetic energy at impact greater than or equal to 11 ft-lbs and a peak incident overpressure greater than or equal to 1.0 psi due to any explosive debris impact when demonstrating that a launch satisfies the probability of impact criterion for waterborne vessels of § 417.107(b)(3).	As long as the Federal Ranges are currently meeting the debris threshold criteria and there is no impact to launch availability for current and proposed vehicle configurations, this is not a problem.	
(4) The analysis must account for any inert or explosive debris impact with a mean expected kinetic energy at impact greater than or equal to 11 ft-lbs when demonstrating whether a launch satisfies the probability of impact criterion for aircraft of §	As long as the Federal Ranges are currently meeting the debris threshold criteria and there is no impact to launch availability for current and proposed vehicle configurations, this is not a problem.	

FAA SNPRM	Suggested Change or Comment	Rationale
417.107(b)(4). The analysis must account for the aircraft velocitv.		
(d) Casualty modeling. **A** probabilistic casualty model must be based on accurate data and scientific principles and must be statistically valid. **A** launch operator must obtain **FAA** approval of any probabilistic casualty model that is used in the flight safety analysis. If the launch takes place from a federal launch range, the analysis may employ any probabilistic casualty model that is accepted as part of the **FAA's** baseline assessment of the federal launch range's safety process..	This is not currently done for Sea Launch, and it is more restrictive than the NPRM. This requires an expensive model as the **FA** states in the Preamble. "Accurate data" – wi the **FAA** provide the data, otherwise it is no easily accessible, and who will determine if is accurate'! Recommend that the detail on how to perfo the analyses and the values to be used in the analyses be removed from the Final Rule an issued separately as an Advisory Circular o some similar means.	Prescribing this level of detail in the rule makes it less flexible and does not permit the evolution of t analyses/values required at this time. These data would be best addressed as part of the SNPRM suggested "focused scientific study" before adopti into law.
(e) Collision avoidance.		
(1) **A** launch operator must ensure that a launch vehicle, any jettisoned components, and its payload do not pass closer than 200 kilometers to a habitable orbital object		
(i) Throughout a sub-orbital launch; and		
(ii) During ascent to initial orbital insertion through at least one complete orbit for an orbital launch.		
(2) **A** launch operator must obtain **a** collision avoidance analysis for each launch from United States Space Command. United States Space Command also calls this analysis a conjunction on launch assessment. Sections 4 17.231 and A4 17.3l of appendix A of this part contain the requirements for obtaining a collision avoidance analysis. **A** launch operator must use the results of the collision avoidance analysis to develop flight commit criteria for collision avoidance as required by § 417.113(b).		
(f) Flight safety analysis. **A** launch operator must perform and document a flight a safety analysis as required by subpart C of this part. **A** launch operator must not initiate flight unless the flight	(f) Flight safety analysis. A launch operator must perform and document a fligh a safety analysis as required by subpart C of this part. **A** launch operator must not initiat	§ 417.203(d) of subpart C states "...the **FAA** will treat the federal launch range's analysis as that of the launch operator..." The use of the word "may' in (f) instead of "will" is equivocal and inconsisten

FAA SNPRM	Suggested Change or Comment	Rationale
safety analysis demonstrates that any risk to the public satisfies the public risk criteria of paragraph (b) of this section. For a licensed launch that involves a federal launch range, the FAA may treat an analysis performed and documented by the federal range as that of the launch operator as provided in § 417.203(d) of subpart C. A launch operator must use the flight safety analysis products to develop flight safety rules that govern a launch. Section 417.113 contains the requirements for flight safety rules.	flight unless the flight safety analysis demonstrates that any risk to the public satisfies the public risk criteria of paragraph (b) of this section. For a licensed launch that involves a federal launch range, the FAA ~~may~~ will treat an analysis performed and documented by the federal range as that of the launch operator as provided in § 417.203(d) of subpart C. ~~A launch operator must use the flight safety analysis products to develop flight safety rules that govern a launch.~~ Section 417.113 contains the requirements for flight safety rules.	with other sections in the SNPRM like § 417.203(d). This provision is very categorical and appears unintentionally to exclude altemate analyses. What about alternate methods'?
11. In § 417.113(b)(1) as proposed to be revised at 65 FR 63982, revise "§ 417.233" to read "§ 417.231".		
12. In § 417.113(b)(2) as proposed to be revised at 65 FR 63982, revise "§ 417.225" to read "§ 417.223"		
13. In § 417.113(c)(4) as proposed to be revised at 65 FR 63983, revise "§ 417.221" to read "§ 417.219".		
14. In § 417.113(c)(5) as proposed to be revised at 65 FR 63983, revise "§ 417.219" to read "§ 417.217".		
15. In § 417.117(h) as proposed to be revised at 65 FR 63984, revise the fourth sentence to read as follows: A post launch report must contain the results of any monitoring of flight environments and any measured wind profiles used for the launch. Section 417.307(b) contains requirements for monitoring flight environments.	Use Section 2.5.9 Statement of Post-Launch Vehicle Performance wording from EWR 127-1.	Note: The FAA did not respond to the previous industry comments for this section in the NPRM. Detailed post-flight analyses are costly and are typically done for only DOD missions as contractual requirements, at the expense of the DOD. While the EWR does require a Statement of Post-Launch Vehicle Performance within 3 months, the level of detail is much less than that proposed by the FAA. The FAA post-flight requirements, therefore, are more demanding and costly to Industry than the EWR post-flight requirements.
16. Revise § 417.121(c) as proposed to be wised at 65 FR 63985 to read as follows:		

FAA SNPRM	Suggested Change or Comment	Rationale
5417.121 Safety critical preflight operations.		
* * * * *		
(c) Collision avoidance. A launch operator must coordinate with United States Space Command to obtain a collision avoidance analysis, also referred to as a conjunction on launch assessment. Sections 417.107(e), 417.231, and A417.31 ofappendix A of this part contain requirements for collision avoidance analysis. A launch operator must develop and incorporate flight commit criteria for collision avoidance as required by § 417.113(b).		
* * * * *		
17. In § 417.121(e)(3) as proposed to be revised at 65 **FR** 63985, revise "§ 417.225" and "§ 417.235" to read "§ 417.223" and "§ 417.233" respectively.		
18. In § 417.121(c)(4) as proposed to be revised at 65 **FR** 63985, revise "§ 417.225" and "§ 417.235" to read "§ 417.223" and "§ 417.233" respectively.		
19. In § 417.121(f) as proposed to be revised at 65 **FR** 63985, revise "§ 417.225" and "§ 417.235" to read "§ 417.223" and "§ 417.233" respectively.		
20. In § 417.121(i) as proposed to be revised at 65 FR 63985, revise "§ 417.235" to read "§ 417.233".		
21. In § 417.125(c)(2) as proposed to be revised at 65 **FR** 63986, revise "§ 417.235" to read "§ 417.233".		
22. In § 417.125(f) as proposed to be revised at 65 **FR** 63986, revise "§ 417.235" to read "§ 417.233".		
23. In § 417.125(g)(2) as proposed to be revised at 65 **FR** 63986, revise "§ 417.235" to read "§ 417.233".		
24. In § 417.323(c) as proposed to be revised at 65 **FR** 64030, revise "§ 417.221(c) with § 417.219(c).		
25. In § 417.327(g)(10) as proposed to be revised at 65 **FR** 64033, revise "§ 417.221" to read "§ 417.219"		

FAA SNPRM	Suggested Change or Comment	Rationale
26. Revise subpart C of part 417 as proposed to be revised at 65 FR 63987 to read as follows:		
Subpart C—Flight Safety Analysis		
417.201 Scope and applicability. 417.203 Compliance 417.205 General. 417.207 Trajectory analysis. 417.209 Malfunction turn analysis. 417.211 Debris analysis. 417.213 Flight safety limits analysis. 417.215 Straight-up time analysis. 417.217 No-longer-terminate gate analysis. 417.219 Data loss flight time and no longer terminate time analyses. 417.221 Time delay analysis. 417.223 Flight hazard area analysis. 417.225 Debris **risk** analysis. 417.227 Toxic release hazard analysis. 417.229 Far-Field overpressure blast effects analysis. 417.231 Collision avoidance analysis. 417.233 Analysis for launch of an unguided suborbital rocket flown with a wind weighting safety system. 417.234-417.300 [Reserved]	NPRM section 417.217 – Wind analysis omitted by SNPRM. Was this the **FAA's** intent'?	

FAA SNPRM	Suggested Change or Comment	Rationale
Subpart C - Flight Safety Analysis		
§ 417.201 Scope and applicability.		
(a) This subpart contains performance rcquircments for performing the flight safety analysis required by § 417.107(f).		
(b) Except as permitted by paragraphs (c) and (d) of this section, the flight safety analysis requirements of this subpart apply to the flight of any launch vehicle that must use a flight safety system as required by § 417.107(a).	There is no problcm with the wording in this section. However, the Industry still has questions and concerns with § 417.107(a) regarding the **FAA's** grandfathering policy. Recommend modifying this paragraph to be compatible with the proposed wording of section 417.1 (a) (l). **For** example, revise paragraph to state **"A** licensed launch of an expendable launch vehicle which utilizes a federal rangc safety organization meets the intent of Part 417 provided an acceptable **FAA** baseline assessmcnt of the range is in effect. If this is the case, the range user's compliance with applicable federal range regulations is acceptable to the **FAA,** the federal rangc safety process remains unchanged, and no demonstration to the **FAA** of compliance to part 417 requirements is required. For a licensed launch from a federal range where the **FAA** baseline assessment identifies discrepancies, the **FAA** will identify the Part 417 requirements that the launch operator must meet to alleviate the discrepancies."	This provides the same level of public safet that exists currcntly. **Also** this implementation is transparent to the launch provider and the vast majority of the existin launch industry. This transparency will minimize the overall cost impact. This also provides via the baseline assessmcnt proces a vehicle for the **FAA** to evaluate the performance of the range, and implement changes to the range safety process.
(c) The flight safety analysis requirements of § 417.233 apply to the flight of any unguided suborbital launch vehicle that uses a wind weighting safety system.		
(d) For any alternative flight safety system approved by the **FAA** under § 417.107(a)(3), the **FAA** will determine during the licensing process which of the analyses required oy this subpart apply.	See comment at SNPRM **§** 417.203(c) below.	

FAA SNPRM	Suggested Change or Comment	Rationale
§ 417.203 Compliance.		
(a) General. A launch operator's flight safety analysis must satisfy the performance requirements of this subpart. The flight safety analysis must also meet the requirements for methods **of** analysis contained in appendices A and B for an orbital launch and appendices B and C for a suborbital launch except as otherwise permitted by this section. A flight safety analysis for a launch may rely on an earlier analysis from an identical or similar launch if the analysis still applies to the later launch.		
(b) Method of analysis. For each launch, a launch operator's flight safety analysis must use methods approved during the licensing process by the FAA, as a license modification, or, if the launch takes place from a federal launch range, approved as part **of** the FAA's baseline assessment of the federal range's processes. Appendix A to this part contains requirements that apply to flight safety methods of analysis. A licensee must submit any change to the methods to the FAA as a request for license modification before the launch to which the proposed change would apply. Section 415.73 contains requirements governing a license modification.	(b) Method of analysis. For each launch, a launch operator's flight safety analysis must use methods approved during the licensing process by the FAA, as a license modification, or, if the launch takes place from a federal launch range, approved as part of the FAA's baseline assessment of the federal range's processes. Appendix A to this part contains requirements that apply to flight safety methods of analysis. ~~A licensee must submit any change to the methods to the FAA as a request for license modification before the launch to which the proposed change would~~ apply. ~~Section 415.73 contains requirements governing a license modification~~	Note: The FAA did not respond to Industry comments to the previous NPRM regarding the launch licensing process. Changes in analysis methodology during mission integration do not require extra paperwork under the current relationship with the Air Force Flight Safety organizations at the Federal Ranges. Filing and tracking launch license modifications increases cost to the Industry and poses a potential threat to launch schedules. The FAA should not prescribe methods of analysis as regulatory requirements. The methods should be contained in Advisory Circulars as recommended approaches or acceptable means. In the event that the FAA retains the provision, the requirement for license modification in the event of *any* change to methods of analysis is excessive. SNPRM § 417.203(b) provides that a licensee **"must** submit any change to the methods **to** the FAA as a request for license modification before the launch to which the proposed

FAA SNPRM	Suggested Change or Comment	Rationale
		change would apply." This language should be revised as follows: "A licensee must submit any material change to the methods to the FAA as a request for license modification . . . ." This is consistent with 14 C.F.R. § 415.73, which also contains a materiality standard. This is not required by the Federal Ranges. It adds cost and impacts schedule.
	This is over restrictive. How does the FAA propose to administer this configuration management function'? Processing could impact launch schedules.	
(c) Alternate analysis. The FAA will approve an alternate flight safety analysis if a launch operator provides a clear and convincing demonstration that its proposed analysis provides an equivalent level **of** safety to that required by this subpart. A launch operator must demonstrate that an altemate flight safety analysis is based on accurate data and scientific principles and is statistically valid. The FAA will not find the launch	(c) Alternate analysis. The FAA will approve an alternate flight safety analysis if launch operator provides a ~~clear and convincing~~ demonstration that its proposed analysis provides an equivalent level of safety **to** that required by this subpart. **A** ~~launch operator must demonstrate that an alternate flight safety analysis is based on~~	The clear and convincing standard is excessive. It is an evidentiary standard inappropriate in a regulatory context, such as this. Note that the Federal Aviation Regulations do not require a clear and convincing demonstration. Nor do the Federal ranges. Both require equivalent level of safety demonstrations.

FAA SNPRM	Suggested Change or Comment	Rationale
operator's application for a license or license modification sufficiently complete to begin review under 413.11 of this chapter until the FAA approves the alternate flight safety analysis.	~~accurate data and scientific principles and is statistically valid.~~ The FAA will not find the launch operator's application for a license or license modification sufficiently complete to begin review under 413.11 of this chapter until the FAA approves the alternate flight safety analysis.	If the launch operator has made a "clear and convincing" demonstration, then it should not be required to make a second demonstration about the accuracy and validity of the data. This provision when read in conjunction with SNPRM § 417.201(d) creates a situation where the licensing process may not begin. SNPRM § 417.203(c) provides that the "FAA will not find the launch operator's application for a license or license modification sufficiently complete to begin review until the FAA approves the alternate flight safety analysis." SNPRM § 417.201(d) provides that the "FAA will determine *during* ***the*** *licensing* ***process*** which of the analyses required by this subpart apply." Such a situation would also conflict with the FAA's mandate under the CSLA to process license applications in 180 days.
(d) Analyses performed by a federal range. The FAA will accept a flight safety analysis used by a federal launch range for a licensed launch, if the launch operator has contracted with a federal launch range for the provision of flight safety analysis for a licensed launch, and the FAA has assessed the range and found that the range's analysis methods satisfy the requirements of this subpart. In this case, the FAA will treat the federal launch range's analysis as that of the launch operator and the launch operator need not provide any further demonstration of compliance.		
(e) Analysis products. For a licensed launch that does not satisfy paragraph (d) of this section, the launch operator must demonstrate to the FAA compliance with the requirements of this subpart, and must include in its demonstration the analysis products required by	(e) Analysis products. For a licensed launch that does not satisfy paragraph (d) of this section, the launch operator must demonstrate to the FAA compliance with the requirements of this subpart ~~and must~~	With an alternate analysis, 417.203(c), the analysis products may be different than defined here.

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FAA SNPRM	Suggested Change or Comment	Rationale
appendices A, B, and C, depending on whether the launch vehicle uses a flight safety system or a wind weighting safety system. **A** launch operator must submit analysis products to the FAA as follows:	~~include in its demonstration the analysis products required by appendices A, B, and C, depending on whether the launch~~ vehicle ~~uses a flight safety system or a wind weighting safety system. A launch operator must submit analysis products to the FAA as follows:~~ Per SNPRM, NPRM Appendix B still stands, again suggest Appendix be removed from NPRM and issued as guideline.	
(1) License application flight safety analysis. At the time of license application, a launch operator must submit the required analysis products as part of the launch operator's safety review document in accordance with § 415.1 15. The FAA will evaluate the analysis to determine whether the methods of analysis for each launch comply with the requirements of this subpart.	There is no problcm with the wording in this section. However, the FAA did not respond to the comments madc by the Industry in § 415.115 of the NPRM. Sea Launch's previous comment to the NPRM still stands in regards to the timing in 415.115. This does not support a compressed flow that commercial space launch operators would like to have.	
(2) Six-month analysis. A launch operator must submit launch specific analysis products to the FAA no later than six months before each planned flight. The launch operator:	(2) Six-month analysis. A launch operator must submit launch spccific analysis products to the FAA ~~no later than~~ at approximately six months before each planned flight. The launch operator:	Note: The FAA did not respond to previou Industry comments regarding the inflcxibl timelines in the licensing process propose the NPRM. Despite EWR 127-1 submittal time requirements, Range practices permit reasonable flexibility in submittal timeline for launch operators, thereby reducing the risk of unnecessary launch delays. The Industry opposes fixed timelines that will become public law without some process allowing relief for submittal dates. See above comment for (1). The SNPRM alleviates the concern partial by allowing reference to previously

FAA SNPKM	Suggested Change or Comment	Rationale
	There is only one submittal to federal ranges currently. Analysis products are delivered "one-at-a-time." Additional submittal at licensing will increase licensing cost/time. Cost/time will depend on availability of applicable analysis products and their acceptance by FAA.	submitted analyses products but it does not change the "no later than 6 months" requirement. EWR 127-1 acknowledges differences in lead times before launch for different applications of new and existing launch vehicles, e.g., single flight azimuth mission (I20 days new, 60 days existing) versus variable flight azimuth mission (12 months new, 6 months existing). These differences in required lead times need to be allowed for in the Final Rule so as to not subject the launch operator to additional schedule constraint and cost.
(i) Must account for vehicle and mission specific input data.		
(ii) May reference previously submitted analysis products and data that are applicable to the launch or data that is applicable to a series of launches.		
(iii) May state that an analysis product has not changed since the launch operator's license application submittal. In this case, the six-month submittal need not repeat the data.	(iii) May state that an analysis product has not changed since the launch operator's license application submittal. In this case, the ~~six-month submittal need not repeat the data~~. the data need not be repeated **in** any new submittal.	The proposed change removes the requirement to repeat data in any future submittal.
(iv) Must identify any analysis product that may change as a flight date approaches and describe what needs to be done to finalize the product and when it will be finalized.	(iv) Must identify any analysis product that may change as a flight date approaches and describe what needs to be done **to** finalize the product and provide an estimate for when it will be finalized.	Again, there must be schedule flexibility due to all the variables involved in launch integration. If the FAA creates regulations with fixed timelines that will become public law, the Industry is concerned that these regulations will be enforced to the letter, resulting in program delays, unnecessary paperwork, unnecessary legal battles, and increased cost.
(v) Must submit the analysis products using the same format and organization used during the license application process.		

FAA SNPRM	Suggested Change or Comment	Rationale
(vi) Must, if requested by the FAA, present the six-month flight safety analysis products in a technical meeting at the FAA.		
(3) Thirty-day flight safety analysis update. A launch operator must submit updated analysis products no later than 30 days before flight. If an analysis product has not changcd since the six-month analysis submittal, the launch operator's thirty-day submittal need not repeat the data. The launch operator:	(3) Thirty-day flight safety analysis update. A launch operator must submit updated analysis products ~~no later than~~ at approximately 30 days before flight. If an analysis product has not changed ~~since the six-month analysis~~ from a previous submittal, the launch operator's thirty-day submittal need not repeat the data. The launch operator:	Note: The FAA did not respond to previous Industry comments regarding the inflexible timelines in the licensing process proposed i the NPRM. Despite EWR 127-1 submittal time requirements, Range practices permit reasonable flexibility in submittal timelines for launch operators. The Industry opposes fixed timelines that will become public law without some process for allowing relief for submittal dates.
(i) Must account for potential variations in input data that may affect the analysis products within the final 30 days prior to flight.	What about unplanned changes forced on the launch operator by Air Force Safety organizations or other circumstances beyond the launch operator's control?	Example: If nearpad trajectories must be re-submitted after L-30 days due to 45 SW/SEOE changes in the Impact Limit Lines, this is an unplanned re-submittal for the launch operator that is required for launch. Launch operators cannot be expecte to predict all potential variations in input data, which is why schedule flexibility is so important. Can the FAA respond to a change at L-30 and not delav launch'?
application.		
(iii) May not change an analysis product within the final 30 days before flight unless the launch operator identified a process for making a change in that period as part of the launch operator's flight safety analysis process and the FAA approved the process through the licensing process.	Does this also apply to unplanned changes forced on the launch operator by Air Force Safety organizations?.	Example: If nearpad trajectories must be re-submitted after L-30 days due to 45 SWISEOE changes in the Impact Limit Lines, this is an unplanned re-submittal for the launch operator that is required for launch. It is impossible for launch operators to predict in advance all changes that may b required during an integration cycle, which i why schedule flexibility is so important.

FAA SNPRM	Suggested Change or Comment	Rationale
(4) Programmatic flight safety analysis. A launc operator need not submit the 6-month or 30-day analy if the launch operator:	**Is** a launch operator who provides alternate flight safety analysis excluded from availing itself of the programmatic flight safety analysis option? **A** provision on the programmatic flight safety analysis needs to be inserted in NPRM § 417.9(b) for consistency with this provision.	
(i) Submits ıl t l products g tl licensing process;	Delete.	This provision requires "complete analysis products." It is unclear what is meant by "complete" analysis products, because in addition to complete analysis products, the launch operator has to demonstrate that the analysis satisfies all the requirements of this subpart and that the analysis does not need t be updated **to** account for launch specific factors. This suggests that "complete" mean more than meeting all requirements and not needing further updates. Is that a requirement that a launch operator with an alternate flight safety system can meet'! **Also,** this would requirc that all the products be complete by the licensing process (415.1 15) 18 mos. before SC gets to the launch site. This is not realistic.
(ii) Demonstrates that the analysis satisfies all th requirements of this subpart; and	(i)(~~ii~~) Demonstrates that the analysis satisfies all the requirements of this subpart; and	
(iii) Demonstrates the analysis does not need to b updated to account for launch specific factors.	(ii)(~~iii~~) Demonstrates the analysis does not need to be updated to account for launch snecific factors.	
§ 417.205 General.		
(a) Public risk management. **A** flight safety analysis must demonstrate that the launch operator wi for each launch, control the risk to the public from hazards associated with normal and malfunctioning	It is recommended that the **FAA** amend the SNPRM to allow for grandfathering of analvses methodologies/products.	The current methods and analyscs that have evolved with time have been shown to achieve the needed safetv levels **and will** maintain costs at current levels.

FAA SNPKM	Suggested Change or Comment	Rationale
launch vehicle flight. The analysis must employ risk assessment or hazard isolation, or a combination of risk assessment and partial isolation of the hazards to demonstrate control of the risk to the public.		
(1) Risk assessment. When demonstrating control of risk through risk assessmcnt, the analysis must demonstrate that any risk to the public satisfies the public risk criteria of § 417.107(b) of this part. The analysis must account for, but need not be limited to, the variability associated with:	This is an additional requirement for analysis above current practice for Sea Launch.	
(i) Each source of a hazard during flight,		
(ii) Normal flight and each failure response mode of the launch vehicle,		
(iii) Each external and launch vehicle flight environment,		
(iv) Populations potentially exposed to the flight, and		
(v) The performance of-any flight safety system, including time delays associatcd with the system.		
(2) Hazard isolation. When demonstrating control of risk through hazard isolation, the analysis must establish the geographical areas from which the public must be excluded during flight and any operational controls needed to isolate all hazards from the public.		
(3) Combination of risk assessment and partial isolation of hazards. When demonstrating control of risk through a combination of risk assessment and partial isolation of the hazards from the public, the analysis must demonstrate that the residual public risk due to any hazard not isolated from the public under paragraph (a)(2) of this section satisfies the public **risk** criteria.		
(b) Dependent analyses. Because some analyses required by this subpart are inherently dependent on one another, the data output of any one analysis must be compatible in form and content with the data input requirements of any other analysis that depends on that output. Figure 417.203-1 illustrates the flight safetv analvses that mieht be oerformed for a launch that uses		

FAA SNPRM	Suggested Change or Comment	Kationale
a flight safety system and the typical dependencies that exist among the analyses.		

FAA SNPRM	Suggested Change or Comment	Rationale

Data Source Analyses (These analyses provide data to the dependent analyses indicated with an X.)	Dependent Analyses (These analyses use data from the data source analyses indicated as input.) Malfunction Turn	Flight Safety Limits	Straight Up Time	No-Longer Terminate Gate	Data Loss Flight Time	Flight Hazard Areas	Debris Risk Analysis	Toxic Release Hazard Analysis	Far Field Overpressure Blast Effects Analysis	Collision Avoidance Analysis
tory Analysis	X	X	X	X	X	X	X	X	X	X
nction Turn Analysis		X	X		X	X	X	X	X	
Analysis		X	X	X	X	X	X	X	X	X
Safety Limits			X	X	X	X	X	X	X	
ht-Up Time								X	X	
nger Terminate Gate					X		X	X	X	
oss Flight Time	X									
Delay Analysis	X	X	X	X	X	X	X	X	X	X

Figure 417.203-1, Illustration of dependent flight safety analyses that might performed for a launch that uses a flight safety system

FAA SNPRM	Suggested Change or Comment	Rationale
§ 417.207 Trajectory analysis.		
(a) General. A flight safety analysis must include a trajectory analysis that establishes:	It is recommended that the FAA amend the SNPRM to allow for grandfathering of analyses methodologies/products.	The current methods and analyscs that have evolved with time have been shown to achieve the needed safety levels and will maintain costs at current levels.
(1) For any time after lift-off, the limits of a launch vehicle's normal flight, as defined by the nominal trajectory and potential three-sigma trajectory dispersions about the nominal trajectory.		
(2) **A** fuel exhaustion trajectory that produces instantaneous impact points with the greatest range for any given time-after-liftoff.		
(3) **A** straight-up trajectory that would result if the launch vehicle malfunctioned and flew in a vertical or near vertical direction above the launch point.		
(b) Trajectory model. A final trajectory analysis must use a six-degree of freedom trajectory model to satisfy the requirements of paragraph (a) of this section.	(b) Trajectory model. A final trajectory analysis must use an acceptable ~~six-degree o freedom~~ trajectory model to satisfy the requirements of paragraph (a) of this section	Note: The FAA did not respond to the Industry's comments regarding this topic in the NPRM. The Delta program has not always utilized six-degrec-of-freedom trajectories for their flight safety analyses. For some analyses, such as developing synthetic three-sigma nearpad and maximum dispersed trajectories, the final trajectory results may be better and easier to obtain with a three-degree-of-freedom trajectory.
(c) Wind effects. **A** trajectory analysis must account for wind effects, including profiles of winds that are no less severe than the worst wind conditions under which flight might be attempted, and must account for uncertainty in the wind conditions.		
§ 417.209 Malfunction turn analysis.		
(a) General. **A** flight safcty analysis must include a malfunction turn analysis that establishes the launch vehicle's turning capability in the event of a malfunction during flight. **A** malfunction turn analysis	(a) General. A flight safety analysis must include a malfunction turn analysis that establishes thr launch vehicle's maximum turning capability in the event of a	There is only need to account for the vehicle's maximum turning capability.

FAA SNPRM	Suggested Change or Comment	Rationale
must account for each cause of a malfunction turn, such as thrust vector offsets or nozzle burn-through. For each cause, the analysis must establish the launch vehicle's turning capability using a set of turn curves The analysis must account for:	malfunction during flight. ~~A malfunction turn analysis must account for each cause of a malfunction turn, such as thrust vector offsets or nozzle burn-through. For each cause, the analysis must establish the launch vehicle's turning capability using a set of turn curves. The analysis must account for:~~ It is recommended that the **FAA** amend SNPRM to allow for grandfathering of analyses methodologies/products.	The current methods and analyses that have evolved with time have been shown to achieve the needed safety levels and will maintain costs at current levels.
(1) **All** trajectory times during the thrusting phases of flight.		
(2) When a malfunction begins to cause each turn throughout the thrusting phases of flight. The analysis must use trajectory time intervals between malfunction turn start times that are short enough to establish smooth and continuous flight safety limits and hazard areas.		
(3) The relative probability of occurrence of each malfunction turn of which the launch vehicle is capable.	(3) **An** estimate of the relative probability of occurrence of each malfunction turn of which the launch vehicle is capable.	This is difficult to quantify in detail unless an extensive, time consuming, and costly fault tree analysis is performed for each vehicle configuration. It will be much easier to provide an estimate for this probability. What is the level of detail expected for satisfying this requirement'?
(4) When each malfunction turn will terminate expressed as a single value or a probability time distribution.		
(5) What terminates each malfunction turn, such as, aerodynamic or inertial breakup.		
(6) The launch vehicle's turning behavior from the time when a malfunction begins to cause a turn until aerodynamic breakup, inertial breakup, or ground impact. The analysis must use trajectory time intervals during the malfunction turn that are short enough to establish turn curves that are smooth and continuous.		
(7) For each malfunction turn, the launch vehicle velocity vector turn angle as a function of time from the start of the turn and measured relative to the nominal		

FAA SNPRM	Suggested Change or Comment	Rationale
launch vehicle velocity vector at the start of the tum.		
(8) For each malfunction turn, the launch vehicle velocity turn magnitude as a function **of** time from the start of the turn and measured relative to the nominal velocity magnitude that corresponds to the velocity vector turn angle.		
(9) For each malfunction turn, the orientation of the launch vehicle longitudinal axis as a function of time from the start of the turn and measured relative to the nominal launch vehicle velocity vector at the start of the turn.		
(b) Set of turn curves for each malfunction turn cause. For cach cause of a malfunction turn, the analysis must establish a set of turn curves that satisfies paragraph (a) of this section and must establish the associated envelope of the set of turn curves. Each set of turn curves must describe thc variation in the malfunction turn characteristics for each cause of the turn. The envelope of each set of curves must define thc limits of the launch vehicle's malfunction turn behavior for each cause of a malfunction turn. For each malfunction turn envelope, the analysis must establish the launch vehicle velocity vector turn angle deviation from the nominal launch vehicle velocity vector. For each malfunction turn envelope, the analysis must establish the vehicle velocity **turn** magnitude deviation from the nominal velocity magnitude that corresponds to the velocity vector turn angle envelope.	(b) Set of turn curves ~~for each malfunction turn cause. For each cause of a malfunction turn,~~ Thc analysis must establish a set of turn curves that satisfies paragraph (a) of this section and must establish the associated envelope of the set of turn curves. ~~Each set of turn curves must describe the variation in the malfunction turn characteristics for each cause of the turn. The envelope of each set of curves must define the limits of the launch vehicle's malfunction turn behavior for each cause of a malfunction turn. For each malfunction turn envelope,~~ The analysis must establish the launch vehicle velocity vector turn angle deviation from the nominal launch vehicle velocity vector. ~~For each malfunction turn envelope,~~ thc analysis must establish the vehicle velocity turn magnitude deviation from the nominal velocity magnitude that corresponds to the velocity vector turn angle envelope.	There is only a need to calculate the maximum turning capability of the vehicle, which does not require calculating turn curves for each possible malfunction.
tj 417.211 Debris analysis.		
(a) General. **A** flight safety analysis must include a debris analysis. For an orbital or suborbital launch, a debris analysis must identify the inert, explosive and other hazardous launch vehicle debris that results from	No comments, assuming, as the FAA has previously asserted, that existing vehicle debris models currently accepted by the Air Force Range Safetv organizations **will** be	

FAA SNPRM	Suggested Change or Comment	Rationale
normal and malfunctioning launch vehiclc flight.	accepted by the FAA.	
(b) Launch vehicle breakup. A debris analysis must account for cach cause of launch vehiclc breakup, such as:		
(1) Any flight termination system activation,		
(2) Launch vehicle explosion,		
(3) Aerodynamic loads,		
(4) Inertial loads.		
(5) Atmospheric reentry heating, and		
(6) Impact of intact vehicle.		
(c) Debris fragment lists. A debris analysis must produce lists of debris fragments for each cause of breakup and any planned jettison of debris, launch vehicle components, or payload. The lists must account for all launch vehicle debris fragments, individually or in groupings of fragments whose characteristics arc similar enough to be described by a single set of characteristics. The debris lists must describe the physical, aerodynamic, and harmful characteristics of each debris fragment, such as:		
(1) Origin on the vehicle;		
(2) Whether it is inert or explosive;		
(3) Weight. dimensions. and shane:		
(4) Lift and drag characteristics;		
(5) Properties of the incremental velocity distribution imparted by breakup; and		
f61 Axial. transverse, and tumbling area.		
§ 417.213 Flight safety limits analysis.		
(a) General. A flight safety analysis must identify the location of populated or other protected areas. The analysis must also establish flight safcty limits that define when a flight safety official must terminate a launch vehicle's flight to prevent the hazardous effects of the resulting debris impacts from reaching any populated or other protected area and ensure that the launch satisfies the public risk criteria of § 417.107(b).	Add statement to the Final Rule acknowledging Air Force control and jurisdiction of thcsc analyses products on the Federal Ranges.	
(b) Flight safety limits. The analysis must	Add statement to the Final Rule	

FAA SNPRM	Suggested Change or Comment	Rationale
establish flight safety limits for use in establishing flight termination rules. Section 417.113(c) contains requirements for flight termination rules. The flight safety limits must account for the temporal and geometric extents on the Earth's surface of a launch vehicle's hazardous debris impact dispersion resulting from any planned or unplanned event for all times during flight. Flight safety limits must account for potential contributions to the debris impact dispersions, such as:	acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	
(1) Time delays, as established by the time delay analysis of § 417.221,		
(2) Residual thrust remaining after flight termination implementation,		
(3) Wind effects,		
(4) Velocity imparted to vehicle fragments by breakup,		
(5) Lift and drag forces on the malfunctioning vehicle and falling debris,		
(6) Vehicle guidance and performance errors,		
(7) Launch vehicle malfunction turn capabilities, and		
(8) Anyuncertainty due to map errors and launch vehicle tracking errors.		
(c) Gates. If a launch involves flight over any populated or other protected area, the flight safety analysis must establish a gate through a flight safety limit. Section 417.217 contains requirements for establishing a gate.	This requirement, taken literally, does not account for some practices at the Western Range, where gates have not been established for overflights of South America, Antarctica, Africa, and Europe. Will this requirement cause a change in the Western Ranee's practices?	
§ 417.215 Straight-up time analysis.		
A flight safety analysis must establish the straight-up time for a launch for use as a flight termination rule. Section 417.113(c) contains requirements for flight termination rules. The analysis must establish the straight-up time as the latest time after liftoff assuming a launch vehicle malfunctioned and flew in a vertical or	The SNPRM/NPRM do not address the issue of Range jurisdiction on analyses or launch control. Launch operators do not have any control over Range operations, and launch operators also have limited visibility of many Range operations; yet, launch operators are	

FAA SNPRM	Suggested Change or Comment	Rationale
near vertical direction above the launch point, at which activation of the launch vehicle's flight termination system or breakup of the launch vehicle would not cause hazardous debris or critical overpressure to affect any populated or other protected area.	responsible for these analyses. The FAA must clarify this situation.	
§ 417.217 No longer terminate gate analysis.		
For a launch that involves flight over a populated or other protected area, the flight safety analysis must include a no longer terminate gate analysis. The analysis must establish the portion, referred to as a gate, of a flight safety limit through which a launch vehicle's tracking representation will be allowed to proceed without requiring the flight to be terminated. A tracking representation is a launch vehicle's present position, instantaneous impact point position, debris impact footprint, or other vehicle performance icon or symbol displayed on a flight safety official console during real-time tracking of the launch vehicle's flight. When establishing a gate in a flight safety limit, the analysis must demonstrate that the launch vehicle flight satisfies the public risk criteria of § 417.107(b).	This requirement, taken literally, does not account for some practices at the Western Range, where gates have not been established for overflights of South America, Antarctica, Africa, and Europe due to the short dwell times and/or minimal risk to the areas overflown. Will this requirement cause a change in the Western Range's practices?	
§ 417.219 Data loss flight time and no longer terminate time analyses.		
(a) General. For each launch, a flight safety analysis must establish data loss flight times, as identified in paragraph (b) of this section, and a no longer terminate time to establish flight termination rules that apply when launch vehicle tracking data is not available to the flight safety official. Section 417.113(c) contains requirements for flight termination rules.	Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	
(b) Data loss flight times. A flight safety analysis must establish the shortest elapsed thrusting time during which a launch vehicle can move from normal flight to a condition where the launch vehicle's hazardous debris impact dispersion extends to any protected area as a data loss flight time. The analysis must establish a data loss flight time for all times along the nominal trajectory	Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	

FAA SNPKM	Suggested Change or Comment	Rationale
from liftoff through the no longer-terminate time established under paragraph (c) of this section.		
(c) No longer terminate time. The analysis must establish a no-longer-terminate time as follows:	Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranees.	
(1) For a suborbital launch, the analysis must establish the no longer terminate time as the time after liftoff that a launch vehicle's hazardous debris impact dispersion can no longer reach any protected area.		
(2) For an orbital launch where the launch vehicle's instantaneous impact point does not overfly a protected area before reaching orbit, the analysis must establish the no-longer terminate time as the time after liftoff that the launch vehicle's hazardous debris impact dispersion can no longer reach any protected area or orbital insertion, whichever occurs first.		
(3) For an orbital launch where a gate permits overflight of a protected area and where orbital insertion occurs aftcr reaching the gate, the analysis must establish the no longer terminate time as the time after liftoff when the time for the launch vehicle's instantaneous impact point to reach the gate is less than the time for the instantaneous impact point to reach any flight safetv limit.		
§ 417.221 Time delay analysis.		
(a) General. A flight safety analysis must include a time delay analysis that establishes the mean elapsed time between the violation of a flight termination rule and the time when a flight safety system is capable of terminating flight for use in establishing the flight safety limits of § 417.213.	Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	
(b) Analysis constraints. A time delay analysis must determine a time delay distribution that accounts for the following:	Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	
(1) The variance of time delay for each potential failure scenario. including but not limited to the ranee of		

FAA SNPRM	Suggested Change or Comment	Rationale
malfunction turn characteristics and the time of flight when the malfunction occurs;		
(2) A flight safety official's decision and reaction time, including variation in human response time, and		
(3) Flight termination hardware and software delays including those delays inherent in:		
(i) Tracking systems;		
(ii) Data processing systems, including filter delays;		
(iii) Display systems;		
(iv) Command control systems: and		
(v) Flight termination systems.		
§ 417.223 Flight hazard area analysis.		
(a) General. A flight safety analysis must include a flight hazard area analysis that identifies any regions of land, sea, or air that **must** be monitored, publicized, controlled, or evacuated in order to control the risk to the public from debris impact hazards. The risk management requirements of § 417.205(a) apply. The analysis must account for, but need not be limited to:	Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	
(1) Trajectory times from liftoff to the no longer terminate time of § 417.219(c).		
(2) Regions of land potentially exposed to debris resulting from normal flight events and events resulting from any potential malfunction.		
(3) Regions of sea and air potentially exposed to debris from normal flight events, including planned impacts.		
(4) In the vicinity of the launch site, any waterborne vessels or aircraft exposed to debris from events resulting from any potential abnormal flight events. includine launch vehicle malfunction.		
(5) Any operational controls implemented to control risk to the public from debris hazards.		
(6) Debris identified by the debris analysis of § 417.211.		
(7) All launch vehicle trajectory dispersion effects		

FAA SNPRM	Suggested Change or Comment	Rationale
in the surface impact domain.		
(b) Public notices. A flight hazard areas analysis must establish the ship and aircraft hazard areas for notices to mariners and notices to airmen. Section 417.121(c) requires notices to mariners and airmen.		
§ 417.225 Debris risk analysis.		
A flight safety analysis must demonstrate that the risk t the public potentially exposed to inert and explosive debris hazards from any one flight of a launch vehicle satisfies the public risk criterion for debris of § 417.107(b)(1). A debris risk analysis must account for risk to populations on land, including regions of launcl vehicle flight following passage through any gate in a flight safety limit established under § 417.217. A debr risk analysis must account for any potential casualtics t the public using the debris thresholds and as required E § 417.107(c).	There is no problem with the wording in this section. However, the Industry does request more information regarding § 417.107(b)( ).	
§ 417.227 Toxic release hazard analysis.		
A flight safety analysis must establish flight commit criteria that ensure compliance with the public risk criterion for toxic release of § 417.107(b)(1). The analysis must account for any toxic release that will occur during the proposed flight of a launch vehicle or that would occur in the event of a flight mishap. The analysis must account for any operational constraints and emergency proccdures that provide protection fron toxic release. The analysis must account for all members of the public who may be exposed to the toxi release, including all members of the public on land an on any waterborne vessels and aircraft except those operated in direct support of the launch.	There is no problem with the wording in this section. However, the Industry does request more information about the toxic Ec criteria. See the comments regarding § 417.107(b)(1). Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	
§ 417.229 Far-field blast overpressure effects analysis.		
(a) General. A flight safety analysis must establish flight commit criteria that ensure com liance	There is no problem with the wording in this section. However, the Industry does request	

FAA SNPRM	Suggested Change or Comment	Rationale
with the public risk criterion for far field blast overpressure of § 417.107(b)(1). The analysis must demonstrate that any far field blast overpressure due to potential explosions during launch vehicle flight will not cause windows to break or that any risk to the public due to potential far field overpressure complies with the public risk criteria.	more information about the proposed 1.0 psi blast overpressure criteria. See the comments regarding § 417.107(b)(1). Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	
(b) Analysis constraints. The analysis must account for:	Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	
(1) The potential for distant focus overpressure or overpressure enhancement given current meteorological conditions and terrain characteristics;		
(2) The potential for broken windows due to peak incident overpressures below 1.0 psi and related casualtics;	There is no problem with the wording in this section. However, the Industry does request more information about the proposed 1.0 psi blast overpressure criteria. See the comments regarding § 417.107(b)(1).	
(3) The explosive capability of the launch vehicle at impact and at altitude and potential explosions resulting from debris impacts, including the potential for mixing of liquid propellants;		
(4) Characteristics of the launch vehicle flight and the surroundings that would affect the population's susceptibility to injury, such as, shelter types and time of day of the proposed launch;		
(5) Characteristics of the potentially affected windows, including their size, location, orientation, glazing material, and condition; and		
(6) The hazard characteristics of the potential glass shards, such as falling from upper building stories or being propelled into or out of a shelter toward potentially occupied spaces.		

FAA SNPRM	Suggested Change or Comment	Rationale
§ 417.231 Collision avoidance analysis.		
(a) General. **A** flight safety analysis must include a collision avoidance analysis that establishes any launch waits in a planned launch window during which a launch operator must not initiate flight, in order to maintain a 200-kilometer separation from any habitable orbiting object. The launch operator must apply any launch waits as flight commit criteria.	Add statement to the Final Rule acknowledging Air Force control and jurisdiction of these analyses products on the Federal Ranges.	
(b) Orbital launch. For an orbital launch, the analysis must establish any launch waits needed to ensure that the launch vehicle, any jettisoned components, and its payload do not pass closer than 200 kilometers to a habitable orbiting object during ascent to initial orbital insertion through at least one complete orbit.		
(c) Suborbital launch. For a suborbital launch, the analysis must establish any launch waits needed to ensure that the launch vehicle, any jettisoned components, and any payload do not pass closer than 200 kilometers to a habitable orbital object throughout the flight.		
§ 417.233 Analysis for an unguided suborbital rocket flown with a wind weighting safety system.		
For launch of an unguided suborbital rocket flown with a wind weighting safety system, the flight safety analysis must establish the launch commit criteria and other launch safety rules that the launch operator must implement to control the risk to the public from potential adverse effects resulting from normal and malfunctioning flight. The risk management requirements of § 417.205(a) apply. The analysis must include a trajectory analysis, flight hazard area analysis, debris risk analysis, and collision avoidance analysis that satisfy § 417.207, § 417.223, § 417.225, and § 417.231, respectively. In addition, for each launch, the analysis must establish any wind constraints under which launch may occur and inciude a wind weighting		

FAA SNPRM	Suggested Change or Comment	Rationale
analysis that establishes the launcher azimuth and elevation settings that correct for the windcocking and wind-drift effects on the unguided suborbital rocket.		
27. Revise appendix A to part 417 as proposed to be revised at 65 FR 64041 to read as follows:		

FAA SNPRM	Suggested Change or Comment	Rationale
APPENDIX A TO PART 417—FLIGHT SAFETY ANALYSIS METHODOLOGIES AND PRODUCTS		
A417.1 Scope.		
This appendix contains requirements that apply to the methods for performing the flight safety analysis required by § 417.107(f) and subpart C of part 417. The methodologies contained in this appendix provide an acceptable means of satisfying the requirements of subpart C and provide a standard and a measure of fidelity against which the FAA will measure any proposed alternative analysis approach. This appendix also identifies the analysis products that a launch operator must submit to the FAA as required by § 417.203(e).	SNPRM, Part 417, Appendix A belongs in an Advisory Circular. Appendix A contains highly detailed technical information on methodologies for accomplishing the requisite safety analyses. According to the FAA, the methodologies provide an "acceptable means of satisfying the requirements of subpart C . . . ." SNPRM, at p. 19487. This suggests that the FAA recognizes that the information on methodologies by its nature is non-binding guidance material, which typically belongs in an Advisory Circular.	
A417.3 Applicability.		
The requirements contained in this appendix apply to a launch operator and the launch operator's flight safety analysis unless the launch operator clearly and convincingly demonstrates that an alternative approach provides an equivalent level of safety. If a federal launch range performs the launch operator's analysis, § 417.203(d) applies. Section A417.33 applies to the flight of any unguided suborbital launch vehicle that uses a wind weighting safety system. All other sections of this appendix apply to the flight of any launch vehicle required to use a flight safety system in accordance with § 417.107(a). For arty alternative flight safety system approved by the FAA in accordance with § 417.107(a)(3), the FAA will determine the applicability of this appendix during the licensing process.		
A417.5 General.		
A launch operator's flight safety analysis must satisfy the requirements for public risk	Delete.	This is unnecessarily repetitious since it was previously stated in the SNPRM. It is not truly

FAA SNPRM	Suggested Change or Comment	Rationale
management and the requirements for the compatibility of the input and output of dependent analyses of § 417.205.		separating the Appendix from the "performance requirements" in the other sections of the NPRM, which leads to confusion.
A417.7 Tra'ector .		
(a) General. **A** flight safety analysis must include a trajectory analysis that satisfies the requirements of § 417.207. The requirements of this section apply to the computation of the trajectories required by § 417.207 and to the trajectory analysis products that a launch operator must submit to the **FAA** as required by § 417.203(e).	Delete.	This is unnecessarily repetitious since it was previously stated in the SNPRM. It is not truly separating the Appendix from the "performance requirements" in the other sections of the NPRM, which leads to confusion.
(b) Wind standards. **A** trajectory analysis must incorporate wind data in accordance with the following:		
(1) For each launch, a trajectory analysis must produce "with-wind" launch vehicle trajectories pursuant to paragraph (f)(6) of this section and do so using composite wind profiles for the month that the launch will take place or composite wind profiles that are as severe or more severe than the winds for the month that the launch will take place.		
(2) **A** composite wind profile used for the trajectory analysis must have a cumulative percentile frequency that represents wind conditions that are at least as severe as the worst wind conditions under which flight would be attempted for purposes of achieving the launch operator's mission. These worst wind conditions must account for the launch vehicle's ability to operate normally in the presence of wind and accommodate any flight safety limit constraints.		
(c) Nominal trajectory. A trajectory analysis must produce a nominal trajectory that describes a launch vehicle's flight path, position and velocity, where all vehicle aerodynamic parameters are as expected, all vehicle internal and external systems		

FAA SNPRM	Suggested Change or Comment	Rationale
perform exactly as planned, and no external perturbing influences other than atmospheric drag and gravity affect the launch vehicle.		
(d) Dispersed traiectories. **A** trajectory analysis must produce the following dispersed trajectories and describe the distribution of a launch vehicle's position and velocity as a function of winds and performance error parameters in the uprange, downrange, left-crossrange and right-crossrange directions.		
(1) Three-sigma maximum and minimum performance traiectories. **A** trajectory analysis must produce a three-sigma maximum performance trajectory that provides the maximum downrange distance of the instantaneous impact point for any given time after lift-off. **A** trajectory analysis must produce a three-sigma minimum performance trajectory that provides the minimum downrange distance of the instantaneous impact point for any given time after lift-off. For any time after lift-off, the instantaneous impact point dispersion of a normally performing launch vehicle must lie between the extremes achieved at that time after lift-off by the three-sigma maximum and three-sigma minimum performance trajectories. The three-sigma maximum and minimum performance trajectories must account for wind and performance error parameter distributions in accordance with the following:		
(i) For each three-sigma maximum and minimum performance trajectory, the analysis must use composite head wind and composite tail wind profiles that represent the worst wind conditions under which a launch would be attempted in accordance with paragraph (b) of this section.		
(ii) Each three-sigma maximum and minimum performance traiectorv must account for all launch vehicle performance error parameters		

FAA SNPRM	Suggested Change or Comment	Rationale
identified in accordance with paragraph (f)(1) of this section that have an effect upon instantaneous impact point range.		
(2) Three-sigma left and right lateral trajectories. **A** trajectory analysis must produce a three-sigma left lateral trajectory that provides the maximum left crossrange distance of the instantaneous impact point for any time after lift-off. **A** trajectory analysis must produce a three-sigma right lateral trajectory that provides the maximum right crossrange distance of the instantaneous impact point for any time after lift-off. For any time after lift-off, the instantaneous impact point dispersion of a normally performing launch vehicle must lie between the extremes achieved at that time after lift-off by the three-sigma left lateral and three-sigma right lateral performance trajectories. The three-sigma lateral performance trajectories must account for wind and performance error parameter distributions in accordance with the following:		
(i) In producing each left and right lateral trajectory, the analysis must use composite left and composite right lateral-wind profiles that represent the worst wind conditions under which a launch would be attempted in accordance with paragraph (b) of this section.		
(ii) The three-sigma left and right lateral trajectories must account for all launch vehicle performance error parameters identified in accordance with paragraph (f)(1) of this section that have an effect on the lateral deviation of the instantaneous impact point.		
(3) Fuel-exhaustion trajectory. **A** trajectory analysis must produce a fuel-exhaustion trajectory for the launch of any launch vehicle with a final suborbital stage that will terminate thrust nominally without burning to fuel exhaustion. The analysis must produce the trajectory that would		

FAA SNPRM	-Suggested Change or Comment	Rationale
occur if the planned thrust termination of the final suborbital stage did not occur. The analysis must produce a fuel-exhaustion trajectory that extends either the nominal trajectory taken through fuel exhaustion of the last suborbital stage or the three-sigma maximum trajectory taken through fuel exhaustion of the last suborbital stage, whichever produces instantaneous impact points with the greatest range for any time after liftoff.		
(e) Straight-up traiectory. A trajectory analysis must produce a straight-up trajectory that begins at the planned time of ignition, and that simulates a malfunction that causes the launch vehicle to fly in a vertical or near vertical direction above the launch point. A straight-up trajectory must last no less than the sum of the straight-up time determined in accordance with A4 17.15 plus the duration of a potential malfunction turn determined in accordance with A4**17.9(b)(2).**		
(f) Analysis process and computations. A trajectory analysis must produce each three-sigma trajectory required by this appendix using a six-degree-of freedom trajectory model and an analysis method, such as root-sum-square or Monte Carlo, that accounts for all individual launch vehicle performance error parameters that contribute to the dispersion of the launch vehicle's instantaneous impact point.	(f) Analysis process and computations. **A** trajectory analysis must produce each three-sigma trajectory required by this appendix using ~~a six-degree-of-freedom model~~ an acceptable trajectory model and an analysis method, such as root-sum-square or Monte Carlo, that accounts for all known and significant individual launch vehicle performance error parameters that contribute to the dispersion of the launch vehicle's instantaneous impact point.	Note: The FAA did not respond to the previous Industry comments regarding this topic in the NPRM. Some programs have not always utilized six-degree-of-freedom trajectories for their flight safety analyses or final products. For some analyses, such as developing synthetic three-sigma nearpad and maximum dispersed trajectories, the final trajectory results may be better and easier to obtain with a three-degree-of-freedom trajectory.
(1) A trajectory analysis must identify all launch vehicle performance error parameters and each parameter's distribution to account for all launch vehicle performance variations and any external forces that can cause offsets from the nominal trajectory during normal flight. A trajectory analysis must account for, but need not be limited to, the following performance error parameters:	(1) **A** trajectory analysis must identify all known and significant launch vehicle performance error parameters and each parameter's distribution to account for ~~all~~ launch vehicle performance variations and any external forces that can cause offsets from the nominal trajectory during normal flight. A trajectory analysis must account for, but need not be limited to, the following performance error parameters:	It is not possible to know all the launch vehicle error parameters and performance variations, and some of the known error parameters are insignificant and do not need to be considered in the analysis.

FAA SNPRM	Suggested Change or Comment	Rationale-
(i) Thrust:		
(ii) Thrust misalignment;		
(iii) Specific impulse;		
(iv) Weight;		
(v) Variation in firing times of the stages;		
(vi) Fuel flow rates;		
(vii) Contributions from the guidance, navigation, and control systems;		
(ix) Steering misalignment: and		
(x) Winds.		
(2) Each three-sigma trajectory must account for the effects of wind from liftoff through the point in flight where the launch vehicle attains an altitude where wind no longer affects the launch **vehicle**		
(g) Traiectow analysis products. The products of a trajectory analysis that a launch operator must submit to the FAA as required by § 417.203(e) must include the following:	Why doesn't the FAA reference the latest version, or the latest proposed version, of the AFSCM 80-12 manual for the required trajectory inputs? This would save a lot of paperwork since many of the items listed below are required by the AFSCM 80-12, which is the standard for the Federal Ranges.	
(1) Assumptions and procedures. **A** description of all assumptions, procedures and models, including the six-degrees-of-freedom model, used in deriving each trajectory.	(1) Assumptions and procedures. A description of all assumptions, procedures and models, including the ~~six-degrees-of-freedom~~ model, used in deriving each trajectory.	Some programs have not always utilized six-degree-of-freedom trajectories for their flight safety analyses or final products. For some analyses, such as developing synthetic three-sigma nearpad and maximum dispersed trajectories, the final trajectory results may be better and easier to obtain with a three-degree-of-freedom trajectory.
(2) Three-sigma launch vehicle performance error parameters. **A** description of each three-sigma performance error parameter accounted for by the trajectory analysis and a description of each parameter's distribution determined in accordance with paragraph (f)(1) of this section.		
(3) Wind profile. **A** graph and tabular listing of each wind profile used in performing the trajectory analysis as required by paragraph (b)(1) of this section and the worst case winds required by paragraph (b)(2) of this section. The graph and		

FAA SNPRM	Suggested Change or Comment	Rationale
tabular wind data must provide wind magnitude and direction as a function of altitude for the air space regions from the Earth's surface to 100,000 feet in altitude for the area intersected by the launch vehicle trajectory. Altitude intervals must not exceed 5000 feet.		
(4) Launch azimuth. The azimuthal direction of the trajectory's "X-axis" at liftoff measured clockwise in degrees from true north.		
(5) Launch point. Identification and location of the proposed launch point, including its name, geodetic latitude (+N), longitude (+E), and geodetic height.		
(6) Reference ellipsoid. The name of the reference ellipsoid used by the trajectory analysis to approximate the average curvature of the Earth and the following information about the model:		
(i) Length of semi-major axis,		
(ii) Length of semi-minor axis,		
(iii) Flattening parameter,		
(iv) Eccentricity,		
(v) Gravitational parameter,		
(vi) Angular velocity of the Earth at the equator, and		
(vii) If the reference ellipsoid is not a WGS-84 ellipsoidal Earth model, the equations that convert the submitted ellipsoid information to the WGS-84 ellipsoid.		
(7) Temporal trajectory items. A launch operator must provide the following temporal trajectory data for time intervals not in excess of one second and for the discrete time points that correspond to each jettison, ignition, burnout, and thrust termination of each stage. If any stage burn time lasts less than four seconds, the time intervals must not exceed **0.2** seconds. The launch operator must provide the temporal trajectory data from launch up to a point in flight when effective thrust of the final stage terminates, or to thrust		

FAA SNPRM	Suggested Change or Comment	Rationale
termination of the stage or burn that places the vehicle in orbit. For an unguided sub-orbital launch vehicle flown with a flight safety system, the launch operator must provide these data for each nominal quadrant launcher elevation angle and payload weight. The launch operator must provide these data on paper in text format and electronically in ASCII text, space delimited format. The launch operator must provide an electronic "readme" tile that identifies the data and their units of measure in the individual disk files.		
(i) Trajectory time-after-liftoff. **A** launch operator must provide trajectory time-after-liftoff measured from first motion of the first thrusting stage of the launch vehicle. The tabulated data must identify the first motion time as T-0 and as the "0.0" time point on the trajectory.		
(ii) Launch vehicle direction cosines. **A** launch operator must provide the direction cosines of the roll axis, pitch axis, and yaw axis of the launch vehicle. The roll axis is a line identical to the launch vehicle's longitudinal axis with its origin at the nominal center of gravity positive towards the vehicle nose. The roll plane is normal to the roll axis at the vehicle's nominal center of gravity. The yaw axis and the pitch axis are any two orthogonal axes lying in the roll plane. The launch operator must provide roll, pitch and yaw axes **of** right-handed systems so that, when looking along the roll axis toward the nose, a clockwise rotation around the roll axis will send the pitch axis toward the yaw axis. The right-handed system must be oriented so that the yaw axis is positive in the downrange direction while in the vertical position (roll axis upward from surface) or positive at an angle of 180 degrees to the downrange direction. The axis may be related to the vehicle's normal orientation with respect to the vehicle's trajectory but, once defined, remain fixed		

FAA SNPRM	Suggested Change **or** Comment	Rationale
with respect to the vehicle's body. The launch operator must indicate the positive direction of the yaw axis chosen. The analysis products must present the direction cosines using the EFG reference system described in paragraph (g)(7)(iv) of this section.		
(iii) X, Y, Z, XD, YD, ZD trajectory coordinates. **A** launch operator must provide the launch vehicle position coordinates (X, Y, Z) and velocity magnitudes (XD, YD, ZD) referenced to an orthogonal, Earth-fixed, right-handed coordinate system. The XY-plane must be tangent **to** the ellipsoidal Earth at the origin, which must coincide with the launch point. The positive X-axis must coincide with the launch azimuth. The positive Z-axis must be directed away from the ellipsoidal Earth. The Y-axis must be positive to the left looking downrange.	Note: The FAA did not respond to the previous Industry comments regarding this topic in the previous NPRM. The Eastern and Western Ranges can process the Range Safety coordinate system data as either a right-handed or a left-handed system. The previous requirement for this coordinate system specified a left-handed system. Software changes may have to be made by launch contractors to produce results in a right-handed system if only a right-handed system becomes mandatory.	
(iv) E, F, G, ED, FD, GD trajectory coordinates. **A** launch operator must provide the launch vehicle position coordinates (E, F, G) and velocity magnitudes (ED, FD, GD) referenced to an orthogonal, Earth fixed, Earth centered, right-handed coordinate system. The origin of the EFG system must be at the center **of** the reference ellipsoid. The E and F axes must lie in the plane of the equator and the G-axis coincides with the rotational axis of the Earth. The E-axis must be positive through 0" East longitude (Greenwich Meridian), the F-axis positive through 90° East longitude, and the G-axis positive through the North Pole. This system must be non-inertial and rotate with the Earth.		
(v) Resultant Earth-fixed velocity. A launch operator must provide the square root of the sum of the squares of the XD, YD, and ZD components of the trajectory state vector.		
(vi) Path angle of velocity vector. A launch operator must provide the angle between the local		

FAA SNPRM	Suggested Change or Comment	Rationale
horizontal plane and the velocity vector measured positive upward from the local horizontal. The local horizontal must be a plane tangent to the ellipsoidal Earth at the sub-vehicle point.		
(vii) Sub-vehicle point. A launch operator must provide sub–vehicle point coordinates that include present position geodetic latitude (+N) and present position longitude (+E). These coordinates must be at each trajectory time on the surface of the ellipsoidal Earth model and located at the intersection of the line normal to the ellipsoid and passing through the launch vehicle center of gravity.		
(viii) Altitude. A launch operator must provide the distance from the sub-vehicle point to the launch vehicle's center of gravity.		
(ix) Present position arc-range. A launch operator must provide the distance measured along the surface of the reference ellipsoid, from the launch point to the sub-vehicle point.		
(x) Total weight. A launch operator must provide the sum of the inert and propellant weights for each time point on the trajectory.		
(xi) Total vacuum thrust. A launch operator must provide the total vacuum thrust for each time point on the trajectory.	(xi) Total vacuum thrust. A launch operator must provide the total ~~vacuum~~ thrust for each time point on the trajectory.	Launch operators provide total thrust adjusted for altitude, not vacuum thrust. The Air Force 80-12 manual also does not specify vacuum thrust as a requirement, just total thrust.
(xii) Instantaneous impact point data. A launch operator must provide instantaneous impact point geodetic latitude (+N), instantaneous impact point longitude (+E), instantaneous impact point arc-range, and time to instantaneous impact. The instantaneous impact point arc-range must consist of the distance, measured along the surface of the reference ellipsoid, from the launch point to the instantaneous impact point. For each point on the trajectory, the time to instantaneous impact must consist of the vacuum flight time remaining until impact if all thrust were terminated at the time		

FAA SNPRM	Suggested Change or Comment	Rationale
point on the trajectory.		
(xiii) Normal trajectory distribution. A launch operator must provide a description of the distribution of the dispersed trajectories required under (d), such as the elements of covariance matrices for the launch vehicle position coordinates and velocity magnitudes.		
A417.9 Malfunction turn.		
(a) General. A flight safety analysis must include a malfunction turn analysis that satisfies the requirements of § 417.209. The requirements of this section apply to the computation of the malfunction turns and the production of turn data required by § 417.209 and to the malfunction turn analysis products that a launch operator must submit to the FAA as required by § 417.203(e).		
(b) Malfunction turn analysis constraints. The following constraints apply to a malfunction turn analysis:		
(1) The analysis must produce malfunction turns that start at a given malfunction start time. The turn must last no less than 12 seconds. These duration limits apply regardless of whether or not the vehicle would breakup or tumble before the prescribed duration of the turn.		
(2) A malfunction turn analysis must account for the thrusting periods of flight along a nominal trajectory beginning at first motion until thrust termination of the final thrusting stage or until the launch vehicle achieves orbit, whichever occurs first.		
(3) A malfunction turn must consist of a 90-degree turn or a turn in both the pitch and yaw planes that would produce the largest deviation from the nominal instantaneous impact point of which the launch vehicle is capable at any time during the malfunction turn in accordance with		

FAA SNPRM	Suggested Change or Comment	Rationale
paragraph (d) of this section.		
(4) The first malfunction turn must start at liftoff. The analysis must account for subsequent malfunction turns initiated at regular nominal trajectory time intervals not to exceed four **seconds.**		
(5) **A** malfunction turn analysis must produce malfunction turn data for time intervals of no less than one second over the duration of each malfunction turn.		
(6) The analysis must assume that the launch vehicle performance is nominal up to the point of the malfunction that produces the turn.		
(7) **A** malfunction turn analysis must not account for the effects of gravity.		
(8) **A** malfunction turn analysis must ensure the tumble turn envelope curve maintains a positive slope throughout the malfunction turn duration as illustrated in figure **A4** 17.9-1. When calculating tumble turns for an aerodynamically unstable launch vehicle, in the high aerodynamic region it often turns out that no matter how small the initial deflection of the rocket engine, the airframe tumbles through 180 degrees, or one-half cycle, in less time than the required turn duration period. In such a case, the analysis must use a 90-degree turn as the malfunction tum.		
(c) Failure modes. **A** malfunction turn analysis must account for the significant failure modes that result in a thrust vector offset from the nominal state. lf a malfunction turn at a malhnction start time can occur as a function of more than one failure mode, the analysis must account for the failure mode that causes the most rapid and largest launch vehicle instantaneous impact point deviation.		
(d) Type of malfunction turn. **A** malfunction turn analvsis must establish the maximum turning capability of a launch vehicle's velocity vector		

FAA SNPRM	Suggested Change or Comment	Rationale
during each malfunction turn by accounting for a 90-degree turn to estimate the vehicle's turning capability or by accounting for trim turns and tumble turns in both the pitch and yaw planes to establish the vehicle's turning capability. When establishing the turning capability of a launch vehicle's velocity vector, the analysis must account for each turn in accordance with the following:		
(1) 90-degree turn. A 90-degree turn must constitute a turn produced at the malfunction start time by instantaneously re-directing and maintaining the vehicle's thrust at 90 degrees to the velocity vector, without regard for how this situation can be brought about.		
(2) Pitch turn. A pitch turn must constitute the angle turned by the launch vehicle's total velocity vector in the pitch-plane. The velocity vector's pitch-plane must be the two dimensional surface that includes the launch vehicle's yaw-axis and the launch vehicle's roll-axis.		
(3) Yaw turn. A yaw turn must constitute the angle turned by the launch vehicle's total velocity vector in the lateral plane. The velocity vector's lateral plane must be the two dimensional surface that includes the launch vehicle's pitch axis and the launch vehicle's total velocity.		
(4) Trim turn. A trim turn must constitute a turn where a launch vehicle's thrust moment balances the aerodynamic moment while a constant rotation rate is imparted to the launch vehicle's longitudinal axis. The analysis must account for a maximum-rate trim turn made at or near the greatest angle of attack that can be maintained while the aerodynamic moment is balanced by the thrust moment, whether the vehicle is stable or unstable.		
(5) Tumble turn. A tumble turn must constitute a turn that results if the launch vehicle's		

FAA SNPRM	Suggested Change or Comment	Rationale
airframe rotates in an uncontrolled fashion, at an angular rate that is brought about by a thrust vector offset angle, and if the offset angle is held constant throughout the turn. The analysis must account for a series of tumble turns, each turn with a different thrust vector offset angle, that are plotted on the same graph for each malfunction start time.		
(6) Turn envelope. A turn envelope must constitute a curve on a tumble turn graph that has tangent points to each individual tumble turn curve computed for each malfunction start time. The curve must envelope the actual tumble turn curves to predict tumble turn angles for each area between the calculated turn curves. Figure **A417.9-1** depicts a series of tumble turn curves and the tumble turn envelope curve.		
(7) Malfunction turn capabilities. When not using a 90-degree turn, a malfunction turn analysis must establish the launch vehicle maximum turning capability in accordance with the following malfunction turn constraints:		
(i) Launch vehicle stable at all angles of attack. If a launch vehicle is so stable that the maximum thrust moment that the vehicle could experience cannot produce tumbling, but produces a maximum-rate trim turn at some angle of attack less than 90 degrees, the analysis must produce a series of trim turns, including the maximum-rate trim turn, by varying the initial thrust vector offset at the beginning of the turn. If the maximum thrust moment results in a maximum-rate trim turn at some angle of attack greater than 90 degrees, the analysis must produce a series of trim turns for angles of attack up to and including 90 degrees.		
(ii) Launch vehicle aerodynamically unstable at all angles of attack. If flying a trim turn is not possible even for a period of only a few seconds, the malfiinction turn analysis need onlv establish tumble turns. Otherwise, the malfunction turn		

FAA SNPRM	Suggested Change or Comment	Rationale
analysis must establish a series of trim turns, including the maximum-rate trim turn, and the family of tumble turns.		
(iii) Launch vehicle unstable at low angles of attack but stable at some higher angles of attack. If large engine deflections result in tumbling, and small engine deflections do not, the analysis must produce a series of trim and tumble turns as required by paragraph (d)(7)(ii) of this section for launch vehicles aerodynamically unstable at all angles **of** attack. If both large and small constant engine deflections result in tumbling, regardless of how small the deflection might be, the analysis must account for the malfunction turn capabilities achieved at the stability angle of attack, assuming no upsetting thrust moment, and must account for the turns achieved by a tumbling vehicle.		
(e) Malfunction turn analysis products. The products of a malfunction turn analysis that a launch operator must submit **to** the FAA as required by § 417.203(e) must include:		
(1) A description of the assumptions, techniques, and equations used in deriving the malfunction turns.		
(2) **A** set of sample calculations for at least one flight hazard area malfunction start time and one downrange malfunction start time. The sample computation for the downrange malfunction must start at a time at least 50 seconds after the flight hazard area malfunction start time or at the time of nominal thrust termination of the final stage minus the malfunction turn duration.		
(3) **A** launch operator must submit malfunction turn data in electronic tabular and graphic formats. The graphs must use scale factors such that the plotting and reading accuracy do not degrade the accuracy of the data. For each malfunction turn start **time** a graph must use the same time scales for the malfunction velocity		

FAA SNPRM	Suggested Change or Comment	Rationale
vector turn angle and malfunction velocity magnitude plot pairs. **A** launch operator must provide tabular listings of the data used to generate the graphs in digital **ASCII** file format. **A** launch operator must submit the data items required in this paragraph for each malfunction start time and for time intervals that do not exceed one second for the duration of each malfunction turn.		
(i) Velocity turn angle graphs. **A** launch operator must submit a velocity turn angle graph for each malfunction start time. For each velocity turn angle graph, the ordinate axis must represent the total angle turned by the velocity vector, and the abscissa axis must represent the time duration of the turn and must show increments not to exceed one second. The series of tumble turns must include the envelope of all tumble turn curves. The tumble turn envelope must represent the tumble turn capability for all possible constant thrust vector offset angles. Each tumble turn curve selected to define the envelope must appear on the same graph as the envelope. **A** launch operator must submit a series of trim turn curves for representative values of thrust vector offset. The series of trim turn curves must include the maximum-rate trim turn. Figure **A4** 17.9-1 depicts an example family **of** tumble turn curves and the tumble turn velocity vector envelope.		
(ii) Velocity magnitude graphs. **A** launch operator must submit a velocity magnitude graph for each malfunction start time. For each malfunction velocity magnitude graph, the ordinate axis must represent the magnitude of the velocity vector and the abscissa axis must represent the time duration of the turn. Each graph must show the abscissa divided into increments not to exceed one second. Each graph must show the total velocity magnitude plotted as a function of time starting with the malfunction start time for		

FAA SNPRM	Suggested Change or Comment	Rationale
each thrust vector offset used to define the corresponding velocity turn-angle curve. **A** launch operator must provide a corresponding velocity magnitude curve for each velocity tumble-turn angle curve and each velocity trim-turn angle curve. For each individual tumble turn curve selected to define the tumble turn envelope, the corresponding velocity magnitude graph must show the individual tumble turn curve's point of tangency to the envelope. The point of tangency must consist of the point where the tumble turn envelope is tangent to an individual tumble turn curve produced with a discrete thrust vector offset angle. A launch operator must transpose the points of tangency to the velocity magnitude curves by plotting a point on the velocity magnitude curve at the same time point where tangency occurs on the corresponding velocity tumble-turn angle curve. Figure **A4** 17.9-2 depicts an example tumble turn velocity magnitude curve.		
(iii) Vehicle orientation. The launch operator must submit tabular or graphical data for the vehicle orientation in the form of roll, pitch, and yaw angular orientation of the vehicle longitudinal axis as a function of time into the turn for each turn initiation time. Angular orientation of a launch vehicle's longitudinal axis is illustrated in figures A4 17.9-3 and **A4 17.9-4.**	The requested data are available, but have not been required in the past by the Air Force Safety organizations at the Federal Ranges. Therefore, the requirement to provide these data is new.	
(iv) Onset conditions. A launch operator must provide launch vehicle state information for each malfunction start time. This state data must include the launch vehicle thrust, weight, velocity magnitude and pad-centered topocentric X, Y, Z, XD. YD. ZD state vector.		
(v) Breakup information. **A** launch operator must specify whether its launch vehicle will remain intact throughout each malfunction turn. If the launch vehicle will breakup during a turn, the		

FAA SNPRM	Suggested Change or Comment	Rationale
launch operator must identify the time for launch vehicle breakup on each velocity magnitude graph. The launch operator must show the time into the turn at which vehicle breakup would occur as either a specific value or a probability distribution for time until breakup.		
(vi) Inflection point. A launch operator must identify the inflection point on each tumble turn envelope curve and maximum rate trim turn curve for each malfunction start time **as** illustrated in figure A417.9-1. The inflection point marks the point in time during the turn where the slope of the curve stops increasing and begins to decrease or, in other words, the point were the concavity of the curve changes from concave up to concave down. The inflection point on a malfunction turn curve must identify the time in the malfunction turn that the launch vehicle body achieves a 90-degree rotation from the nominal position. On a tumble turn curve the inflection point must represent the start of the launch vehicle tumble.		
A417.11 Debris.		
(a) General. A flight safety analysis must include a debris analysis that satisfies the requirements of § 417.211. The requirements of this section apply to the debris data required by § 417.211 and the debris analysis products that a launch operator must submit to the FAA as required by § 417.203(e).	Again, unnecessary repetition with previous SNPRM sections.	
(b) Debris analysis constraints. A debris analysis must produce the debris model described in paragraph (c) of this section. The analysis must account for all launch vehicle debris fragments, individually or in groupings of fragments called classes. The characteristics of each debris fragment represented by a class must be similar enough to the characteristics of all the other debris fragments represented by that class that all the		

FAA SNPRM	Suggested Change or Comment	Rationale
debris fragments of the class can be described by a single set of characteristics. Paragraph (c)(10) of this section applies when establishing a debris class. **A** debris model must describe the physical, aerodynamic, and harmful characteristics **of** each debris fragment either individually or as a member of a class. **A** debris model must consist of lists **of** individual debris or debris classes for each cause of breakup and any planned jettison of debris, launch vehicle components, or payload. **A** debris anal sis must account for:		
activation of any flight termination system. The anal sis must account for:		
The effects of debris produced when flight termination system activation destroys an intact malfunctioning vehicle.		
(ii) Spontaneous breakup of the launch vehicle, if the breakup is assisted by the action of any inadvertent separation destruct system.		
(iii) The effects of debris produced by the activation of any flight termination system after inadvertent breakup of the launch vehicle.		
(2) Debris due to any malfunction where forces on the launch vehicle may exceed the launch vehicle's structural integrity limits.		
(3) The immediate post-breakup or jettison environment of the launch vehicle debris, and any change in debris characteristics over time from launch vehicle breakup or jettison until debris impact.		
(4) The impact overpressure, fragmentation, and secondary debris effects of any confined or unconfined solid propellant chunks and fueled components containing either liquid or solid propellants that could survive to impact, as a function of vehicle malfunction time.		
(5) The effects of impact of the intact vehicle **as** a function of failure time. The intact impact		

FAA SNPRM	Suggested Change **or** Comment	Rationale
debris analysis must identify the trinitrotoluene (TNT) yield of impact explosions, and the numbers **of** fragments projected from all such explosions, including non-launch vehicle ejecta and the blast overpressure radius. The analysis must use a model for TNT yield of impact explosion that accounts for the propellant weight at impact, the impact speed, the orientation **of** the propellant, and the impacted surface material.		
(c) Debris model. **A** debris analysis must produce a model of the debris resulting from planned jettison and from unplanned breakup **of** a launch vehicle for use **as** input to other analyses, such as establishing flight safety limits and hazard areas and performing debris risk, toxic, and blast analyses. **A** launch operator's debris model must satisfy the following:		
provide the debris fragment data required by this section for the launch vehicle flight from the planned ignition time until the launch vehicle achieves orbital velocity for an orbital launch. For a sub-orbital launch, the debris model must provide the debris fragment data required by this section for the launch vehicle flight from the planned ignition time until thrust termination of the last thrusting stage. **A** debris model must provide debris fragment data for the number of time periods sufficient to meet the requirements for smooth and continuous contours used to define		

FAA SNPRM	Suggested Change or Comment	Rationale
payload fairing jettison, and other normal hardware jettison activities.		
(3) Exolosive and non-exolosive propellant fragments. A debris model must identify all propellant fragments that are explosive or non-explosive upon impact. The debris model must describe each propellant fragment as a function of time, from the time of breakup through ballistic Free-fall to impact. The debris model must describe the characteristics of each fragment, including its origin on the launch vehicle, representative dimensions and weight at the time of breakup and at the time of impact. For those fragments identified as un-contained or contained propellant fragments, whether explosive or non-explosive, the debris model must identify whether or not burning occurs during free fall, and provide the consumption rate during free fall. The debris model must identify:		
(i) Solid propellant that is exposed directly to the atmosphere and that bums but does not explode upon impact as "un-contained non-explosive solid propellant."		
(ii) Solid or liquid propellant that is enclosed in a container, such as a motor case or pressure vessel, and that burns but does not explode upon impact as "contained non-explosivegropellant."		
(iii) Solid or liquid propellant that is enclosed in a container, such as a motor case or pressure vessel, and that explodes upon impact as "contained explosive propellant fragment."		
(iv) Solid propellant that is exposed directly to the atmosphere and that explodes upon impact as "un-contained explosive solid propellant fragment."		
(4) Other non-inert debris fragments. In addition to the explosive and flammable fragments required bv paragraph (c)(3) of this section. a debris model must identify any other non-inert		

FAA SNPRM	Suggested Change or Comment	Rationale
debris fragments, such as toxic or radioactive fragments, that present any other hazards to the public.		
(5) Fragment weight. At each modeled breakup time, the individual fragment weights must approximately add up to the sum total weight of inert material in the vehicle and the weight of contained liquid propellants and solid propellants that are not consumed in the initial breakup or conflagration.		
(6) Fragment imparted velocity. A debris model must identify the maximum velocity imparted to each fragment due to potential explosion or pressure rupture. When accounting for imparted velocity, a debris model must:		
(i) Use a Maxwellian distribution with the specified maximum value equal to the 97th percentile; or	Note: The FAA did not respond to the previous Industry comments regarding this topic in the NPRM. Launch operators typically estimate imparted velocities using a simpler, but conservative, methodology that has been accepted by the Air Force Range Safety organizations at the Federal Ranges.	
(ii) If a debris model does not use a Maxwellian velocity distribution, the analysis products must identify the distribution, and must state whether or not the specified maximum value is a fixed value with no uncertainty.	Note: The FAA did not respond to the previous Industry comments regarding this topic in the NPRM. Launch operators typically estimate imparted velocities using a simpler, but conservative, methodology that has been accepted by the Air Force Range Safety organizations at the Federal Ranges.	
(7) Fragment projected area. A debris model must include the axial, transverse, and mean tumbling areas of each fragment. If the fragment may stabilize under normal or malfunction conditions, the debris model must also provide the projected area normal to the drag force.	Note: The FAA did not respond to the previous Industry comments regarding this topic in the NPRM. Launch operators typically provide the standard piece area or a maximum projected area for each	

FAA SNPRM	Suggested Change or Comment	Rationale
	debris piece.	
(8) Fragment ballistic coefficient. A debris model must include the axial, transverse, and tumble orientation ballistic coefficient for each fragment's projected area as required by paragraph (c)(7) of this section.	Note: The FAA did not respond to the previous Industry comments regarding this topic in the NPRM. Launch operators typically calculate average subsonic and supersonic ballistic coefficients for each debris piece.	
(9) Debris fragment count. A debris model must include the total number of each type of fragment required by paragraphs (c)(2), (c)(3), and (c)(4) of this section and created by a malfunction.		
(10) Fragment classes. A debris model must categorize malfunction debris fragments into classes where the characteristics of the mean fragment in each class conservatively represent every fragment in the class. The model must define fragment classes for fragments whose characteristics are similar enough to be described and treated by a single average set of characteristics. A debris class must categorize debris by each of the following characteristics, and may include any other useful characteristics:		
(i) The type of fragment, defined by paragraphs (c)(2), (c)(3), and (c)(4) of this section. All fragments within a class must be the same type, such as inert or explosive.		
(ii) Debris subsonic ballistic coefficient (β_{sub}). The difference between the smallest $\log_{10}(\beta_{sub})$ value and the largest $\log_{10}(\beta_{sub})$ value in a class must not exceed 0.5, except for fragments with β_{sub} less than or equal to three. Fragments with β_{sub} less than or equal to three may be grouped within a class.	Note: The FAA did not respond to the previous Industry comments regarding this topic in the NPRM. This is a new requirement for launch operators.	
Breakup-imparted velocity **(AV).** A debris model must categorize fragments **as** a function of the range of **AV** for the fragments within a class and the class's median subsonic ballistic coefficient.	Note: The FAA did not respond to the previous Industry comments regarding this topic in the NPRM. This is a new requirement for launch operators.	

FAA SNPRM	Suggested Change or Comment	Rationale
For each class, the debris model must keep the ratio of the maximum breakup-imparted velocity (ΔV_{max}) **to** minimum breakup-imparted velocity (ΔV_{min}) within the following bound: $\frac{V_{max}}{\Delta V_{min}} < \frac{5}{2+\log_{10}(\beta'_{sub})}$ Where: β'_{sub} is the median subsonic ballistic coefficient for the fragments in a class.		
(d) Debris analysis products. The products of a debris analysis that a launch operator must submit to the **FAA** as required by § 417.203(e) must include:		
(1) Debris model. The launch operator's debris model that satisfies the requirements of this section.		
(2) Fragment description. A description of the fragments contained in the launch operator's debris model. The description must identify the fragment as a launch vehicle part or component, describe its shape, representative dimensions, and may include drawings of the fragment.		
(3) Intact impact TNT yield. For an intact impact of a launch vehicle, for each failure time, a launch operator must identify the TNT yield of each impact explosion and blast overpressure hazard radius.		
(4) Fragment class data. The class name, the range of values for each parameter used to categorize fragments within a fragment class, and the number of fragments in any fragment class established in accordance with paragraph (c)(10) of this section.		
(5) Ballistic coefficient. The mean ballistic coefficient (β) and plus and minus three-sigma values of the β for each fragment class. **A** launch operator must provide graphs of the coefficient of drag (C_D) as a function of Mach number for the	Launch operators typically calculate average subsonic and supersonic ballistic coefficients for each debris piece and do not consider piece stability.	

FAA SNPRM	Suggested Change or Comment	Rationale
nominal and three-sigma β variations for each fragment shape. The launch operator must label each graph with the shape represented by the curve and reference area used to develop the curve. A (C_L) vs. Mach number and the C_d vs. Mach number curves. The launch operator must provide the equations for each C_d vs. Mach curve.		
(6) Pre-flight propellant weight. The initial preflight weight of solid and liquid propellant for each launch vehicle component that contains solid or liquid propellant.		
(7) Normal propellant consumption. The nominal and plus and minus three-sigma solid and liquid propellant consumption rate, and pre-malfunction consumption rate for each component that contains solid or liquid propellant.		
(8) Fragment weight. The mean and plus and minus three-sigma weight of each fragment or fragment class.		
(9) Projected area. The mean and plus and minus three-sigma axial, transverse, and tumbling areas for each Fragment or fragment class. This information is not required for those fragment classes classified as burning propellant classes under (e)(17) of this section.	Launch operators typically provide the standard piece area or a maximum projected area for each debris piece.	
(10) Imparted velocities. The maximum incremental velocity imparted to each fragment class created by flight termination system activation, or explosive or overpressure loads at	Launch operators typically estimate imparted velocities using a simpler, but conservative, methodology that has been accepted bv the Air Force Range Safety organizations at the Federal	

FAA SNPRM	Suggested Change or Comment	Rationale
breakup. The launch operator must identify the velocity distribution as Maxwellian or must define the distribution, including whether or not the specified maximum value is a fixed value with no uncertaintv.	Ranges.	
(11) Fragment type. The fragment type for each fragment established in accordance with paragraphs (c)(2), (c)(3), and (c)(4) of this section.		
(12) Origin. The part of the launch vehicle from which each fragment originated.		
(13) Burning propellant classes. The propellant consumption rate for those fragments that burn during free-fall.		
(14) Contained propellant fragments, explosive or non-explosive. For contained propellant fragments, whether explosive or non-explosive, a launch operator must provide the initial weight of contained propellant and the consumption rate during free-fall. The initial weight of the propellant in a contained propellant fragment is the weight of the propellant before any of the propellant is consumed by normal vehicle operation or failure of the launch vehicle.		
(15) Solid propellant fragment snuff-out pressure. The ambient pressure and the pressure at the surface of a solid propellant fragment, in pounds per square inch, required to sustain a solid propellant fragment's combustion during free-fall.		
(16) Other non-inert debris fragments. For each non-inert debris fragment identified in accordance with paragraph (c)(4) of this section, a launch operator must describe the diffusion, dispersion, deposition, radiation, or other hazard exposure characteristics used to determine the effective casualty area required by paragraph (c)(9) of this section.		
(17) Residual thrust dispersion. For each thrusting or non-thrusting stage having residual thrust capability following a launch vehicle		

FAA SNPRM	Suggested Change or Comment	Rationale
malfunction, a launch operator must provide either the total residual impulse imparted or the full-residual thrust in foot-pounds as a function of breakup time. For any stage not capable of thrust after a launch vehicle malfunction, a launch operator must provide the conditions under which the stage is no longer capable of thrust. For each stage that can be ignited as a result of a launch vehicle malfunction on a lower stage, a launch operator must identify the effects and duration of the potential thrust, and the maximum deviation of the instantaneous impact point which can be brought about by the thrust. A launch operator must provide the explosion effects of all remaining fuels, pressurized tanks, and remaining stages, particularly with respect to ignition or detonation of upper stages if the flight termination system is activated during the burning period of a lower stage.		
A417.13 Flight safety limits.		
(a) General. A flight safety analysis must include a flight safety limits analysis that satisfies the requirements of § 417.213. The requirements **of** this section apply to the computation of the flight safety limits and identifying the location of populated or other protected areas as required by § 417.213 and to the analysis products that the launch operator must submit to the FAA as required by § 417.203(e).	More repetition.	
(b) Flight safety limits constraints. The analysis must establish flight safety limits in accordance with the following:		
(1) Flight safety limits must account for potential malfunction of a launch vehicle during the time from launch vehicle first motion through flight until the no longer terminate time determined as required by **A41**7.19.		
(2) For a flight termination at any time during		

FAA SNPRM	Suggested Change or Comment	Ratinnale
launch vehicle flight, the flight safety limits must:		
(i) Represent no less than the extent of the debris impact dispersion for all debris fragments with a ballistic coefficient greater than or equal to three; and	(i) Represent no less than the extent of the debris impact dispersion for all debris fragments with ~~a ballistic coefficient greater than or equal to three~~ an impact kinetic energy less than or equal to 11 ft-lbs; and	If impact kinetic energy is required for analyses pertaining to inert debris, shouldn't it be applied here as well?
(ii) Ensure that the debris impact area on the Earth's surface that is bounded by the debris impact dispersion in the uprange, downrange and crossrange directions does not extend to any populated or other protected area.		
(3) Each debris impact area determined by a flight safety limits analysis must be offset in a direction away from populated or other protected areas. The size of the offset must account for all parameters that may contribute to the impact dispersion. The parameters must include:		
(i) Launch vehicle malfunction tum capabilities.		
(ii) Effective casualty area produced in accordance with A417.25(b)(8).		
(iii) All delays in the identification of a launch vehicle malfunction.		
(iv) Malfunction imparted velocities, including any velocity imparted to vehicle fragments by breakup.		
(v) Wind effects on the malfunctioning vehicle and falling debris.		
(vi) Residual thrust remaining after flight termination.		
(vii) Launch vehicle guidance and performance errors.		
(viii) Lift and drag forces on the malfunctioning vehicle and falling debris including variations in drag predictions of fragments and debris.		
(ix) All hardware and software delays during implementation nf flight termination		
(x) All debris impact location uncertainties		

FAA SNPRM	Suggested Change or Comment.	Rationale
caused by conditions prior to, and after, activation of the flight termination system.		
(xi) Any other impact dispersion parameters peculiar to the launch vehicle.		
(xii) All uncertainty due to map errors and launch vehicle tracking errors.		
(c) Risk management. The requirements for public risk management of § 417.205(a) apply to a flight safety limits analysis. When employing risk assessment, the analysis must establish flight safety limits that satisfy paragraph (b) of this section, account for the products of the debris risk analysis performed in accordance with A417.25, and ensure that any risk to the public satisfies the public risk criteria of § 417.107(b) of this part. When employing hazard isolation, the analysis must establish flight safety limits in accordance with the following:		
(1) The flight safety limits must account for the maximum deviation impact locations for the most wind sensitive debris fragment with a minimum of 11 ft-lbs of kinetic energy at impact,		
(2) The maximum deviation impact location of the debris identified in (c)(1) of this section for each trajectory time must account for the three-sigma impact location for the maximum deviation flight, and the launch day wind conditions that produce the maximum ballistic wind for that debris.		
(3) The maximum deviation flight must account for the instantaneous impact point, of the debris identified in (c)(1) at breakup, that is closest to a protected area and the maximum ballistic wind directed from the breakup point toward that protected area.		
(d) Flight safety limits analysis products. The products of a flight safety limits analysis that a launch operator must submit to the FAA as reauired bv § 417.203(e) must include:		

FAA SNPRM	Suggested Change or Comment	Rationale
(1) A description of each method used to develop and implement the flight safety limits. The description must include equations and example computations used in the flight safety limits analysis.		
(2) A description of how each analysis method meets the analysis requirements and constraints of this section, including how the method produces a worst case scenario for each impact dispersion area.		
(3) A description of how the results of the analysis are used to protect populated and other protected areas.		
(4) A graphic depiction or series of depictions of the flight safety limits, the launch point, all launch site boundaries, surrounding geographic area, all protected area boundaries, and the nominal and three-sigma launch vehicle instantaneous impact point ground traces from liftoff to orbital insertion or the end of flight. Each depiction must have labeled geodetic latitude and longitude lines. Each depiction must show the flight safety limits at trajectory time intervals sufficient to depict the mission success margin between the flight safety limits and the protected areas. The launch vehicle trajectory instantaneous impact points must be plotted with sufficient frequency to provide a conformal representation of the launch vehicle's instantaneous impact point ground trace curvature.		
(5) A tabular description of the flight safety limits, including the geodetic latitude and longitude for any flight safety limit. The table must contain quantitative values that define flight safety limits. The quantitative values must be rounded to the number of significant digits that can be determined from the uncertainty of the measurement device used to determine the flight		

FAA SNPRM	Suggested Change or Comment	Rationale
safety limits and must be limited to a maximum of six decimal places.		
(6) **A** map error table of direction and scale distortions as a function of distance from the point of tangency from a parallel of true scale and true direction or from a meridian of true scale and true direction. **A** launch operator must provide a table of tracking error as a function of downrange distance from the launch point for each tracking station used to make flight safety control decisions. **A** launch operator must submit a description of the method, showing equations and sample calculations, used to determine the tracking error. The table must contain the map and tracking error data points within 100 nautical miles of the reference point at an interval of one data point every 10 nautical miles, including the reference point. The table must contain map and tracking error data points beyond 100 nautical miles from the reference point at in interval of one data point every 100 nautical miles out to a distance that includes all populated or other areas protected by the flight safetv limits.		
(7) **A** launch operator must provide the equations used for geodetic datum conversions and one sample calculation for converting the geodetic latitude and longitude coordinates between the datum ellipsoids used. **A** launch operator must provide any equations used for range and bearing computations between geodetic coordinates and one sample calculation.		
A417.15 Straight-up time.		
(a) General. **A** flight safety analysis must include a straight-up time analysis that satisfies the requirements of § **4**17.215. The requirements of this section apply to the computation of straight-up time as required by § 417.215 and to the analysis products that the launch operator must submit to	More repetition.	

FAA SNPRM	Suggested Change or Comment	Rationale
the FAA as required by § 417.203(e). The analysis must establish a straight-up time as the latest time-after-liftoff, assuming a launch vehicle malfunctioned and flew in a vertical or near vertical direction above the launch point, at which activation of the launch vehicle's flight termination system or breakup of the launch vehicle would not cause hazardous debris or critical overpressure to affect any populated or other protected area.		
(b) Straight-up time constraints. A straight-up-time analysis must account for the following:		
(1) Launch vehicle trajectory. The analysis must use the straight-up trajectory determined in accordance with A417.7(e).		
(2) Sources of debris impact dispersion of A417.13(b)(3)(iii) through (xii)		
(b) Straight-up time analysis products. The products of a straight-up-time analysis that a launch operator must submit to the FAA as required by § 417.203(e) must include:		
(1) The straight-up-time.		
(2) A description of the methodology used to determine straight-up time.		
A417.17 No-longer terminate gate.		
(a) General. The flight safety analysis for a launch that involves flight over a populated or other protected area must include a no-longer terminate gate analysis that satisfies the requirements of § 417.217. The requirements of this section apply to determining a gate as required by § 417.217 and the analysis products that the launch operator must submit to the FAA as required by § 417.203(e). The analysis must determine the portion, referred to as a gate, of a flight safety limit, through which a launch vehicle's tracking representation will be allowed to	More repetition.	

FAA SNPRM	Suggested Change or Comment	Rationale
proceed without flight termination.		
(b) No-longer-terminate Pate analysis constraints. The following analysis constraints apply to a gate analysis.		
(1) For each gate in a flight safety limit, the criteria used for determining whether io allow passage through the gate or to terminate flight at the gate must use all the same launch vehicle flight status parameters as the criteria used for determining whether to terminate flight at a flight safety limit. For example, if the flight safety limits are a function of instantaneous impact point location, the criteria for determining whether to allow passage through a gate in the flight safety limit must also be a function of instantaneous impact point location. Likewise, if the flight safety limits are a function of drag impact point, the gate criteria must also be a function of drag impact point.		
(2) When establishing a gate in a flight safety limit, the analysis must ensure that the launch vehicle flight satisfies the public risk criteria of § 417.107(b).		
(3) For each established gate, the analysis must account for:		
(i) All launch vehicle tracking and map errors.		
(ii) All launch vehicle plus and minus three-sigma trajectory limits.		
(iii) All debris impact dispersions.		
(4) The width of a gate must restrict a launch vehicle's normal trajectory ground trace.		
(c) No-longer-terminate gate analysis products. The products of a gate analysis that a launch operator must submit to the FAA as required by § 417.203(e) must include:		
(1) A description of the methodology used to estabiish each gate.		

FAA SNPRM	Suggested Change or Comment	Ratinnale
(2) **A** description of the tracking reoresentation.		
(3) **A** tabular description **of** the input data.		
(4) Example analysis computations performed to determine a gate. If a launch involves more than one gate and the same methodology is used to determine each gate, the launch operator need only submit the computations for one of the gates.		
(5) **A** graphic depiction **of** each gate. **A** launch operator must provide a depiction or depictions showing flight safety limits, protected area outlines, nominal and 3-sigma left and right trajectory ground traces, protected area overflight regions, and predicted impact dispersion about the three-sigma trajectories within the gate. Each depiction must show latitude and longitude grid lines, gate latitude and longitude labels, and the map scale.		
A417.19 Data loss flight time and no longer terminate time.		
(a) General. **A** flight safety analysis must include **a** data **loss** flight time analysis that satisfies the requirements of **§ 417.219.** The requirements of this section apply to the computation of data **loss** flight times and the no longer terminate time required by **§ 417.219,** and to the analysis products that the launch operator must submit to the **FAA** as required by § 417.203(e).	More repetition.	
(b) No longer terminate time. The analysis must establish a no longer terminate time for a launch in accordance with the following:		
(1) For a suborbital launch, the analysis must determine a no longer terminate time as the time after liftoff that a launch vehicle's hazardous debris impact dispersion can no longer reach any protected area.		
(2) For an orbital launch where the launch		

FAA SNPRM	Suggested Change or Comment	Rationale
vehicle's instantaneous impact point does not overfly a protected area prior to reaching orbit, the analysis must establish the no-longer terminate time as the time after liftoff that the launch vehicle's hazardous debris impact dispersion can no longer reach any protected area or orbital insertion, whichever occurs first.		
(3) For an orbital launch where a gate permits overflight of a protected area and where orbital insertion occurs after reaching the gate, the analysis must determine the no longer terminate time as the time after liftoff when the time for the launch vehicle's instantaneous impact point to reach the gate is less than the time for the instantaneous impact point to reach any flight safety limit.		
(4) The analysis must account for a malfunction that causes the launch vehicle to proceed from its position at the trajectory time being evaluated toward the closest flight safety limit and protected area.		
(5) The analysis must account for the launch vehicle thrust vector that produces the highest instantaneous impact point range-rate that the vehicle is capable of producing at the trajectory time being evaluated.		
(c) Data loss flight times. For each launch vehicle trajectory time, from the predicted earliest launch vehicle tracking acquisition time until the no longer terminate time, the analysis must determine the data loss flight time in accordance with the following:		
(1) The analysis must determine each data loss flight time as the minimum thrusting time for a launch vehicle to move from a normal trajectory position to a position where a flight termination would cause the malfunction debris impact dispersion to reach any protected area.		
(2) A data loss flight time analysis must		

FAA SNPRM	Suggested Change or Comment	Rationale
account for a malfunction that causes the launch vehicle to proceed from its position at the trajectory time being evaluated toward the closest flight safety limit and protected area.		
(3) The analysis must account for the launch vehicle thrust vector that produces the highest instantaneous impact point range-rate that the vehicle is capable of producing at the trajectory time being evaluated.		
(4) Each data loss flight time must account for the system delays at the time of flight,		
(5) The analysis must determine a data loss flight time for time increments that do not exceed one second along the launch vehicle nominal trajectory.		
(d) Products. The products of a data loss flight time and no longer terminate time analysis that a launch operator must submit as required by § 417.203(e) must include:		
(1) A launch operator must describe the methodology used in its analysis, and identify all assumptions, techniques, input data, and equations used. A launch operator must submit calculations performed for one data loss flight time in the launch area and one data loss flight time that is no less than 50 seconds later in the downrange area.		
(2) A launch operator must submit a graphical description or depictions of the flight safety limits, the launch point, the launch site boundaries, the surrounding geographic area, any protected areas, the no longer terminate time within any applicable scale requirements, latitude and longitude grid lines, and launch vehicle nominal and three-sigma instantaneous impact point ground traces from liftoff through orbital insertion for an orbital launch, and through final impact for a suborbital launch. Each graph must show any launch vehicle trajectory instantaneous impact points plotted with sufficient frequency to		

FAA SNPRM	Suggested **Change or Comment**	**Rationale**
provide a conformal estimate of the launch vehicle's instantaneous impact point ground trace curvature. **A** launch operator must provide labeled latitude and longitude lines and the map scale on the depiction.		
(3) **A** launch operator must provide a tabular description of each data loss flight time. The tabular description must include the malfunction start time and the geodetic latitude (positive north of the equator) and longitude (positive east of the Greenwich Meridian) coordinates of the intersection of the launch vehicle instantaneous impact point trajectory with the flight safety limit. The table must identify the first data lost flight time and no longer terminate time. The tabular description must include data loss flight times for trajectory time increments not to exceed one second.		
A417.21 Time delay.		
(a) General. **A** flight safety analysis must include a time delay analysis that satisfies the requirements of § 417.221. The requirements of this section apply to the computation of time delays associated with a flight safety system and other launch vehicle systems and operations as required by § 417.221 and to the analysis products that the launch operator must submit to the **FAA** as required by § 417.203(e).	More repetition.	
(b) Time delay analysis constraints. The analysis must account for all significant causes of time delay between the violation of a flight termination rule and the time when a flight safety system is capable of terminating flight in accordance with the following:		
(1) The analysis must account for decision and reaction times, including variation in human response time, for flight safety official and other personnei that are part of a launch operator's flight		

FAA SNPRM	Suggested Change or Comment	Rationale
safety system as defined by subpart D of this part.		
(2) The analyses must determine the time delay inherent in any data, from any source, used by a flight safety official for making flight termination decisions.		
(3) **A** time delay analysis must account for all significant causes of time delay, including data flow rates and reaction times, for hardware and software, including, but not limited to the following:		
(i) Tracking system. **A** time delay analysis must account for time delays between the launch vehicle's current location and last known location and that are associated with the hardware and software that make up the launch vehicle tracking system, whether or not it is located on the launch vehicle, such as transmitters, receivers, decoders, encoders, modulators, circuitry and any encryption and decryption of data.		
(ii) Display systems. **A** time delay analysis must account for delays associated with hardware and software that make up any display system used by a flight safety official to aid in making flight control decisions. **A** time delay analysis must also account for any manual operations requirements, tracking source selection, tracking data processing, flight safety limit computations, inherent display delays, meteorological data processing, automated or manual system configuration control, automated or manual process control, automated or manual mission discrete control, and automated or manual failover decision control.		
(iii) Flight termination system and command control system. **A** time delay analysis must account for delays and response times associated with flight termination system and command control system hardware and software, such as transmitters. decoders. encoders. modulators. relays and shutdown, arming and destruct devices,		

FAA SNPRM	Suggested Change or Comment	Rationale
circuitry and any encryption and decryption of data.		
(iv) Software specific time delays. A delay analysis must account for delays associated with any correlation of data performed by software, such as timing and sequencing; data filtering delays such as error correction, smoothing, editing, or tracking source selection; data transformation delays; and computation cycle time.		
(4) A time delay analysis must determine the time delay plus and minus three-sigma values relative to the mean time delay.		
(5) For use in any risk analysis, a time delay analysis must determine time delay distributions that account for the variance of time delays for potential launch vehicle failures, including but not limited to, the range of malfunction turn characteristics and the time of flight when the malfunction occurs.		
(c) Time delay analysis products. The products of a time delay analysis that a launch operator must submit as required by § 417.203(e) must include:		
(1) A description of the methodology used to produce the time delay analysis.		
(2) A schematic drawing that maps the flight safety official's data flow time delays from the start of a launch vehicle malfunction through the final commanded flight termination on the launch vehicle, including the flight safety official's decision and reaction time. The drawings must indicate major systems, subsystems, major software functions, and data routing.		
(3) A tabular listing of each time delay source and its individual mean and plus and minus three-sigma contribution to the overall time delay. The table must provide all time delay values in milliseconds.		
(4) The mean delay time and the plus and		

FAA SNPRM	Suggested Change or Comment	Rationale
minus three-sigma values of the delay time relative to the mean value.		
A417.23 Flight hazard areas.		
(a) General. A flight safety analysis must include a flight hazard area analysis that satisfies the requirements of § 417.223. The requirements of this section apply to the determination of flight hazard areas for orbital and ballistic launch vehicles that use a flight termination system to protect the public as required by § 417.223 and to the analysis products that the launch operator must submit to the FAA as required by § 417.203(e). Requirements that apply to determining flight hazard areas for unguided suborbital rockets that use a wind weighting safety system are contained in appendix C of this part.	More repetition.	
(b) Launch site flight hazard area. A flight hazard area analysis must establish a launch site flight hazard area that encompasses the launch point and:		
(i) If the flight safety analysis employs hazard isolation to establish flight safety limits in accordance with A417.13(c), the launch site flight hazard area must encompass the flight safety limits.		
(ii) If the flight safety analysis does not employ hazard isolation to establish the flight safety limits, the launch site flight hazard area must encompass all hazard areas established in accordance with paragraphs (d) through (j) of this section. Figure A417.23-1 illustrates a launch site flight hazard area for a coastal launch site. Figure A417.23-2 illustrates a launch site flight hazard area for an inland launch site.		
(c) Flinht corridor. For regions outside the flight hazard area, the analysis must define a flight corridor that extends downrange from a flight hazard area as illustrated by figure A417.23-3.		

FAA SNPRM	Suggested Change **or** Comment	Rationale
The flight safety limits established in accordance with **A417.13** must bound the flight corridor. The flight corridor must include any land overflight permitted by a gate established in accordance with **A417.17. A** five-sigma cross range trajectory dispersion about the nominal launch vehicle trajectory must bound any land overflight area. **A** flight corridor must extend for all downrange positions from the flight hazard area to the no longer terminate time determined in accordance with **A4** 17.19.		
(d) Debris impact hazard area. The analysis must establish a debris impact hazard area that accounts for the effects of impacting debris resulting from normal and malfunctioning launch vehicle flight, except for toxic effects, and accounts for potential impact locations of all debris fragments. The analysis must establish a debris hazard area in accordance with the following:		
(1) An individual casualty contour that defines where the risk to an individual would exceed an expected casualty (E_C) criteria of 1×10^{-6} if one person were assumed to be in the open and inside the contour during launch vehicle flight must bound a debris hazard area. The analysis must produce an individual casualty contour in accordance with the following:		
(i) The analysis must account for the location of a hypothetical person, and must vary the location of the person to determine when the risk would exceed the E, criteria of 1×10^{-6}. The analysis must count a person as a casualty when the person's location is subjected to any inert debris impact with a mean expected kinetic energy greater than or equal to 11 ft-lbs or a peak incident overpressure equal to or greater than one psi due to explosive debris impact. The analysis must determine the peak incident overpressure using the	Prior to establishing the 11 ft-lbs kinetic energy and 1 psi overpressure criteria in any Final Rule, the Industry requests a briefing on these topics and, if it has not already been accomplished, the results of launch availability studies for all current and proposed vehicle configurations if the proposed criteria are enforced.	

FAA SNPRM	Suggested Change or Comment	Rationale
Kingery-Bulmash relationship, without regard to sheltering, reflections, or atmospheric effects.		
(ii) The analysis must account for person locations that are no more than 1000 feet apart in the downrange direction and no more than 1000 feet apart in the crossrange direction to produce an individual casualty contour. For each person location, the analysis must sum the probabilities of casualty over all flight times for all debris groups.		
(iii) An individual casualty contour must consist of curves that are smooth and continuous. To accomplish this, the analysis must vary the time interval between the trajectory times assessed so that each location of a debris impact point is less than one-half sigma of the downrange dispersion distance.		
(2) The input for determining a debris impact hazard area must account for the results of the trajectory analysis required by A417.7, the malfunction turn analysis required by A4 17.9, and the debris analysis required by A4 17.11 to define the impact locations of each class of debris established by the debris analysis, and the time delay analysis required by A4 17.21.		
(3) The analysis must account for the extent of the impact debris dispersions for each debris class produced by normal and malfunctioning launch vehicle flight at each trajectory time. The analysis must also account for how the vehicle breaks up, either by the flight termination system or by aerodynamic forces, if the different breakup may result in a different probability of existence for each debris class. A debris impact hazard area must account for each impacting debris fragment classified in accordance with A4 17.11(c).		
(4) The analysis must account for launch vehicle flight that exceeds a flight safety limit. The analvsis must also account for trajectory conditions that maximize the mean debris impact		

FAA SNPRM	Suggested Change or Comment	Rationale
distance during the flight safety system delay time determined in accordance with **A4** 17.21 and account for a debris model that is representative of a flight termination or aerodynamic breakup. For each launch vehicle breakup event, the analysis must account for trajectory and breakup dispersions, variations in debris class characteristics, and debris dispersion due to any wind condition under which a launch would be attempted.		
(5) The analysis must account for the probability of failure of each launch vehicle stage and the probability of existence of each debris class. The analysis must account for the probability of occurrence of each type of launch vehicle failure. The analysis must account for vehicle failure probabilities that vary depending on the time of flight.		
(6) In addition to failure debris, the analysis must account for nominal jettisoned body debris impacts and the corresponding debris impact dispersions. The analysis must use a probability of occurrence of 1.0 for the planned debris fragments produced by normal separation events during flight.		
Near-launch-point blast hazard area. **A** flight hazard area analysis must define a blast overpressure hazard area as a circle extending from the launch point with a radius equal to the 1.0-psi overpressure distance produced by the equivalent TNT weight of the explosive capability of the vehicle. In addition, the analysis must establish a minimum near-pad blast hazard area to provide protection from hazardous fragments potentially propelled by an explosion. The analysis must account for the maximum possible total solid and liquid propellant explosive potential of the launch vehicle and any payload. The analysis must define a blast overpressure hazard	Prior to establishing the 1 psi overpressure requirement in any Final Rule, the Industry requests a briefing on these topics and, if it has not already been accomplished, the results of launch availability studies for all current and proposed vehicle configurations if the proposed criteria are enforced.	

FAA SNPRM	Suggested Change or Comment	Rationale
area using the following equations: $R_{op} = 45 \cdot (NEW)^{1/3}$ Where: R_{op} is the over pressure distance in feet. NEW = $W_E \cdot C$ (pounds). W_E is the weight of the explosive in pounds. C is the TNT equivalency coefficient of the propellant being evaluated. **A** launch operator must identify the TNT equivalency of each propellant on its launch vehicle including any payload. TNT equivalency data for common liquid propellants is provided in tables **A41**7-1. Table **A4**17-2 provides factors for converting gallons of specified liquid propellants to pounds.		
(f) Other hazards. **A** flight hazard area analysis must identify any additional hazards, such as radioactive material, that may exist on the launch vehicle or payload. For each such hazard, the analysis must determine a hazard area that encompasses any debris impact point and its dispersion and includes an additional hazard radius that accounts for potential casualty due to the additional hazard. Analysis requirements for toxic release and far field blast overpressure are provided in § **4**17.27 and **A4**17.29, respectively.		
(g) Ship-hit contours. **A** flight hazard area analysis must establish ship hazard areas, referred to as ship-hit contours, to ensure that the probability of hitting a ship satisfies the collective probability threshold of 1×10^{-5} required by § 417.107(b) and to determine the area that may need to be surveyed on the day of launch. The analysis must determine the need to survey the ship hazard areas in accordance with paragraph (h) of this section. When paragraph (h) requires surveillance, a launch operator must not initiate flight while the number of ships within any ship-hit contour is greater than or equal to the number of ships for which the contour was established.		

FAA SNPRM	Suggested Change or Comment	Rationale
The flight hazard area must encompass all ship-hit contours. The analysis must establish the ship-hit contours in accordance with the following:		
(1) A ship-hit contour must account for the size of the largest ship that could be located in the flight hazard area. The analysis must demonstrate that the ship size used represents the largest ship that could be present in the flight hazard area or, if the ship size is unknown, the analysis must use a ship size of 120,000 square feet. Additional contours may be established for smaller vessels if necessary to facilitate surveillance of the flight hazard area while ensuring that the 1×10^{-5} hit criteria is satisfied.		
(2) The analysis must determine ship-hit contours for one to 10 ships in increments of one ship. For each given number of ships, the associated ship-hit contour must bound an area around the nominal instantaneous impact point trace where, if the given number of ships were located on the contour, the collective probability of impacting any ship would be less than or equal to the 1×10^{-5} shin-hit criteria.		
(3) Each ship-hit contour must account for all debris as determined in accordance with A4 17.11. Each contour must account for each mean debris impact point and the extent of the impact dispersion for each simulated launch vehicle failure for increasing trajectory times, starting at liftoff. Each debris impact dispersion must account for the variance in winds, the aerodynamic properties of the debris and the variance in velocity of the debris resulting from vehicle breakup, the malfunction turn capabilities of the launch vehicle, and guidance and performance errors. The analysis must also account for the type of vehicle breakup, either by the flight termination system or by aerodynamic forces that may result in different debris characteristics.		

FAA SNPRM	Suggested Change or Comment	Rationale
(4) Each ship-hit contour must account for any inert debris impact with mean expected kinetic energy at impact greater than or equal to 11 ft-lbs and peak incident overpressure of greater than or equal to 1.0 psi due to any explosive debris impact. A ship-hit contour must consists of curves that are smooth and continuous. To accomplish this, the analysis must vary the time interval, between the trajectory times assessed such that the distance between each debris impact point location for each time assessed is less than one-half sigma of the downrange dispersion distance.	If the Federal Ranges are currently meeting the debris threshold criteria without any negative launch availability issues, then this is not an issue for the Industry.	
(5) Each ship-hit contour must account for each nominal staging event and potential launch vehicle failure that may result in vehicle breakup in the flight hazard area. Each contour must account for the probability of failure of each launch vehicle stage and the probability of existence of each debris class. The analysis must account for each launch vehicle failure as a function of probability of occurrence. The analysis must account for each launch vehicle failure probability as a function of flight time. The analysis must account for all potential debris created by flight termination and aerodynamic breakup and the probability of occurrence of each. Each contour must account for breakup through aerodynamic breakup or a flight termination action and the different debris that would result from each type of breakup. The analysis must account for any planned debris impact, such as a stage or payload fairing impact and a probability of existence equal to the probability of success for the planned debris impact.		
(h) Ship surveillance in the launch site flight hazard area. The launch site flight hazard area need not be surveyed for ships during the launch countdown if the analysis demonstrates, using statistical ship density data, that the total		

FAA SNPRM	Suggested Change or Comment	Rationale
probability of a ship impact occurring is less than or equal to 1×10^{-5}. The analysis must establish whether a launch operator must conduct ship surveillance in the launch site flight hazard area for a launch in accordance with the following:		
(1) The analysis must determine ship density for the launch site flight hazard area based on accurate statistical data. The ship density for the launch site flight hazard area must account for factors that affect the ship density, such as time of day. The analysis must use statistical ship density for the launch site flight hazard area multiplied by a safety factor of 10 unless the analysis includes a clear and convincing demonstration of the accuracy of the ship density data, and accounts for the associated ship density error in the collective ship-hit probability analysis.	Do the Air Force Safety organizations at the Federal Ranges currently employ a safety factor of 10 in their analyses? If not, what is the impact to launch availability'?	
(2) The analysis must establish the expected number of ships inside the IO-ship contour determined in accordance with paragraph (g) of this section, by determining the total water surface area within the IO-ship contour and multiplying this area by the ship density determined in accordance with paragraph (h)(1) of this section. If the resulting number of ships is less than 10, the launch operator need not perform ship surveillance in the flight hazard area. If the resulting number of ships is equal to or greater than 10, the launch operator must perform ship surveillance in the flight hazard area as required by § 417.121(f).		
(i) Ship hazard area for notice to mariners. Regardless of whether ship surveillance is required in accordance with paragraph (h) of this section, the launch operator must provide the ship-hit contour for 10 ships determined in accordance with paragraph (e) of this section as a notice to mariners as required by § 417.121(e).		
(j) Launch site flight hazard area aircraft-hit contour. A flight hazards area analysis must		

FAA SNPRM	Suggested Change or Comment	Rationale
determine an aircraft-hit contour to be surveyed on the day of launch to ensure that the probability of hitting an aircraft satisfies the individual probability threshold of 1×10^{-8} as required by § 417.107(b) for the flight hazard area around the launch point. The launch site flight hazard area must contain an aircraft-hit contour that extends for altitudes from zero to 60,000 feet. The analysis must determine an aircraft-hit contour in accordance with the following:		
(1) An aircraft-hit contour must bound an area around the nominal instantaneous impact point trace where, if an aircraft were located on the contour, the individual probability of impacting the aircraft would be less than or equal to 1×10^{-8}.		
(2) The analysis must account for the dimension of the largest aircraft operated in the vicinity of the launch or, if unknown, the dimensions of a Boeing 747 aircraft.		
(3) The analysis must account for all debris as determined under A417.11. An aircraft-hit contour must account for aircraft velocity and debris with kinetic energy relative to the aircraft greater than or equal to 11 ft-lbs.	Prior to establishing the 11 ft-lbs kinetic energy requirement in any Final Kule, the Industry requests a briefing on these topics and, if it has not already been accomplished, the results of launch availability studies for all current and proposed vehicle configurations if the proposed criteria are enforced.	
(4) The analysis must account for each nominal staging event and potential vehicle failure that may result in vehicle breakup. The analysis must account for each vehicle failure as a function of probability of occurrence and as a function of time.		
(5) The analysis must account for all debris for both flight termination and for aerodynamic breakup and the probability of occurrence of the debris. The analysis must account for each mean debris impact point and the extent of the debris impact dispersion.		
(k) Flight corridor ship hazard areas. Within		

FAA SNPRM	Suggested Change or Comment	Hationale
a flight corridor but outside of a launch site flight hazard area, the analysis must determine a ship hazard area for each planned dcbris impact for the issuance of notices to mariners. Each ship hazard area must consist of an area centered on a planned impact point and must be defined by the larger of the three-sigma impact dispersion ellipse or an ellipse with thc same semi-major and semi-minor axis ratio as thc impact dispersion, where, if a ship were located on the boundary of the ellipse, the probability of hitting the ship would be less than or equal to 1×10^{-5}. The analysis must establish each flight corridor ship hazard area in accordance with C417.5(h) and C417.5(i) ofappendix C, which apply to both orbital and suborbital launch. The analysis must demonstrate whcthcr surveillance of a ship hazard area must take place as required by C417.5(g) of appendix C of this part.		
(l) Flight corridor aircraft hazard areas. Within a flight corridor but outside of a launch site flight hazard area, thc analysis must establish an aircraft hazard area for each planned debris impact for the issuance of notices to airmen in accordance with § 417.121(e). Each aircraft hazard area must encompass an air space region, from an altitude of 60,000 feet to impact on the Earth's surface, that contains the larger of the three-sigma drag impact dispersion or an ellipse with the same semi-major and semi-minor axis ratio as the impact dispersion, where, if an aircraft wcrc located on the boundary of the ellipse, the probability of hitting the aircraft would be less than or equal to 1×10^{-8}. The flight safety analysis must determine flight corridor aircraft hazard areas for both orbital and suborbital launch using the methodology contained in paragraph C417.5(f) of appendix C of this part.		
(m) Flight hazard area analysis products. The products of a flight hazard area analysis that a launch operator must submit to the FAA in		

FAA SNPKM	Suggested Change or Comment	Rationale
accordance with § 417.203(c) must include, but need not be limited to:		
(1) A chart that depicts the launch site flight hazard area. including its size and location.		
(2) A chart that depicts each hazard area required by this section.		
(3) A description of each hazard for which analysis was performed; the methodology used to compute each hazard area; and the debris classes for aerodynamic breakup of the launch vehicle and for flight termination. For each debris class, the launch operator must identify the number of debris fragments, the variation in ballistic coefficient, and the standard deviation of the debris dispersion.		
(4) A chart that depicts each of the ship-hit contours, the individual casualty contour, and the aircraft-hit contour.		
(5) A chart that depicts the flight corridor, including any regions of land overflight.		
(6) A description of the aircraft hazard area for each planned debris impact inside the flight corridor, the information to be published in a Notice to Airmen, and all information required as part of any agreement with the **FAA** ATC office having jurisdiction over the airspace through which flight will take place.		
(7) A description of any ship hazard area for each planned debris impact inside the flight corridor and all information required in a Notice to Mariners.		
(8) A description of the methodology used for determining each hazard area.		
(9) A description of the hazard area operational controls and procedures to be implemented for flight.		
A417.25 Debris risk.		
(a) General. A flight safety analysis must		

FAA SNPRM	Suggested Change or Comment	Rationale
include a dcbris risk analysis that satisfies the requirements of § 417.225. The rcquirements of this section apply to the computation of the average number of casualties (E_c) to the collective members of the public exposed to inert and explosive dcbris hazards from the proposed flight of a launch vehicle as required by § 417.225 and to the analysis products that the launch operator must submit to the FAA as required by § 417.203(e).		
(b) Debris risk analysis constraints. The following constraints apply to a debris risk anal**vsis**.		
(1) A debris risk analysis must use the methodologies and equations of appendix **B** of this part.		
(2) A dcbris risk analysis must account for the following populations:		
(i) The overflight of populations located inside any flight safety limits.		
(ii) All populations located within five-sigma left and right crossrange of a nominal trajectory instantaneous impact point ground trace and within five-sigma of each planned nominal debris impact.	(ii) All populations located within five-sigma left and right crossrangc of a nominal trajectory instantaneous impact point ground trace and within five-sigma of each planned nominal debris impact.	Note: The **FAA** did not respond to the Industry comments on this topic in the NPKM. The distance left and right of the nominal instantaneous impact point trace for population centers should not be fixed for downrange dcbris risk assessments. It should be **up** to the analyst, based on the change in the total Ec duc to the inclusion of more distant population centers, to prove whether or not the inclusion of additional population centers further away has any significant change to the Ec results. **Also,** what is the origin of the 5-sigma limit'?
(iii) Any planned overflight of the public within any gate overflight areas.		
(iv) Any populations outside the flight safety limits identified in accordance with paragraph (b)(10) of this section.		
(3) A debris risk analysis must account for	Prior to establishing the 11 ft-lbs kinetic cnergv	

FAA SNPRM	Suggested Change or Comment	Rationale
both inert and explosive debris hazards produced from any impacting debris caused by normal and malfunctioning launch vehicle flight. The analysis must account for the debris classes determined by the debris analysis required by **A41**7.11. **A** debris risk analysis must account for any inert debris impact with mean expected kinetic energy at impact greater than or equal to 11 ft-lb and peak incident overpressure of greater than or equal to 1.0 psi due to any explosive debris impact. The analysis must account for all debris hazards as a function of flight time.	and 1 psi overpressure criteria in any Final Rule the Industry requests a bricfing on these topics and, if it has not already been accomplished, the results **of** launch availability studies for all curre and proposed vehicle configurations if the proposed criteria are enforced.	
(4) **A** debris risk analysis must account for debris impact points and dispersion for each class of debris in accordance with the following:		
(i) **A** debris risk analysis must account for drag corrected impact points and dispersions for each class of impacting debris resulting from normal and malfunctioning launch vehicle flight as a function of trajectory time from lift-off through orbital insertion, including each planned impact, for an orbital launch, and through final impact for a suborbital launch.		
(ii) The dispersion for each debris class must account for the position and velocity state vector dispersions at breakup, the variance produced by breakup imparted velocities, the variance produced by winds, the variance produced by aerodynamic properties for each debris class, and any other dispersion variances.		
(iii) **A** debris risk analysis must account for the survivability of debris fragments that are subject to reentry aerodynamic forces or heating. **A** debris class may be eliminated from the debris risk analysis if the launch operator demonstrates that the debris will not survive to impact.		
(5) **A** debris risk analysis must account for launch vehicle failure probability. The following constraints appiy:		

FAA SNPRM	Suggested Change or Comment	Rationale
(i) For a launch vehicle with fewer that 15 flights, a launch operator must use a launch vehicle failure probability of 0.31.	(i) For a launch vehicle with fewer that IS flights, a launch operator must use a launch vehicle failure probability ~~of 0.31~~ jointly established by the FAA, Air Force Range Safety organizations, and the launch operator.	Note: The FAA did not respond to the Industry NPRM comments on this tbpic. Establishing a fixed number for failure probability does not promote flexibility, or considcr the design of the rocket, or the rocket manufacturer's success/failure record for new vehicles.
(ii) Fora launch vehicle with at least 15 flights, but fewer than 30 flights, a launch operator must use a launch vehicle failure probability of 0.10 or the empirical failure probability, whichever is greater.	(ii) For a launch vehicle with at least 15 flights, but fewer than 30 flights, a launch operator ~~must use a launch vehicle failure probability of 0.10 or the empirical failure probability, whichever is greater~~ must use a failure probability established jointly by the FAA. the Air Force Range Safety organizations. and the launch operator.	Note: The FAA did not respond to the Industry NPRM comments on this topic. Establishing a fixed number for failure probability does not promote flexibility, or consider the design of the rocket, or the rocket manufacturer's success/failure record for new vehicles.
(iii) For a launch vehicle with 30 or more flights, a launch operator must use the empirical failure probability determined from the actual flight history.	(iii) For a launch vehicle with 30 or more flights, a launch operator must use the ~~empirical~~ failure probability ~~determined from the actual flight history~~ established jointly by the FAA, the Air Force Range Safety organizations, and the launch operator.	Note: The FAA did not respond to the Industry NPRM comments on this topic. Establishing a fixed number for failure probability does not promote flexibility, or consider the design of thc rocket, or the rocket manufacturer's success/failure record for new vehicles.
(iv) For a launch vehicle with a prcviously established failure probability that undergoes a modification to a stage, and the modification could affect the reliability of that stage, the launch operator must apply the previously established failure probability to all unmodified stages and the failure probability requirements of paragraphs (b)(5)(i) through (b)(5)(iii) of this section to the modified stage.	(iv) For a launch vehicle with a previously established failure probability that undergoes a modification to a stage, and the modification could negatively affect thc reliability of that stage, the launch operator must apply the previously established failure probability to all unmodified stages and the failure probability requirements of paragraphs (b)(5)(i) through (b)(5)(iii) of this section to the modified stage.	Note: The FAA did not respond to thc Industry NPRM comments on this topic. Design modifications demonstrably improve stage reliability, e.g., added redundancy, should not force the stage failure probability to increase.
(6) A debris risk analysis must account for the dwell time of the instantaneous impact point ground trace over each populated or protected area being evaluated.		
(7) A debris risk analysis must account for the three-sigma instantaneous impact point trajectory variations in left-crossrange, right-crossrange, uprange, and downrange as a function		

FAA SNPRM	Suggested Change or Comment	Rationale
of trajectory time, due to launch vehicle performance variations as determined by the trajectory analysis performed in accordance with A417.7.		
(8) A debris risk analysis must account for the effective casualty area as a function of launch vehicle flight time for all impacting debris generated from a catastrophic launch vehicle malfunction event or a planned impact event. The effective casualty area must account for both payload and vehicle systems and subsystems debris. The effective casualty area must account for all debris fragments determined as part of a launch operator's debris analysis in accordance with A417.11. The effective casualty area for each explosive debris fragment must account for a 1.0-psi blast overpressure radius and the projected debris effects for all potentially explosive debris. The effective casualty area for each inert debris fragment must:		
(i) Account for bounce, skip, slide, and splatter effects; or	Note: The **FAA** did not respond to the Industry NPRM comments on this topic. These effects may be overly conservative for downrange overflight debris risk analyses. This is a topic for discussion and resolution among all of the Range Safety community prior to any Final Rule.	
(ii) Equal seven times the maximum projected area of the fragment.	Note: The **FAA** did not respond to the Industry NPKM comments on this topic. These effects may be overly conservative for downrange overflight debris risk analyses. This is a topic for discussion and resolution among all of the Range Safety community prior to any Final Rule.	
(9) **A** debris risk analysis must account for current population density data obtained from a current population database for the region being	(9) **A** debris risk analysis must utilize the population database and population growth rate data available trom the FAA or the Air Force	Note: The **FAA** did not respond to the Industry NPRM comments on this topic.

FAA SNPRM	Suggested Change or Comment	Rationale
evaluated or by estimating the current population using exponential population growth rate equations applied to the most current historical data available. The population model must define population centers that are similar enough to be described and treated as a single average set of characteristics without degrading the accuracy of the debris risk estimate.	Range Safety organizations.	The population model should be maintained and provided by the FAA or the Air Force Range Safety organizations.
(10) For a launch vehicle that uses a flight safety system, a debris risk analysis must account for the collective risk to any populations outside the flight safety limits in the area surrounding the launch site during flight, including people who will be at any public launch viewing area during flight. For such populations, in addition to the constraints listed in paragraphs (b)(1) through (b)(9) of this section, a launch operator's debris risk analysis must account for the following:		
(i) The probability of a launch vehicle failure that would result in debris impact in protected areas outside the flight safety limits.		
(ii) The failure rate of the launch operator's flight safety system. **A** flight safety system failure rate of 0.002 may be used if the flight safety system complies with the flight safety system requirements of subpart D of this part. For an alternate flight safety system approved in accordance with § 417.107(a)(3), the launch operator must demonstrate the validity of the probability of failure through the licensing process.	(ii) The failure ~~rate~~ probability of the launch operator's flight safety system. **A** flight safety system failure ~~rate~~ probability of 0.002 may be used if the flight safety system complies with the flight safety system requirements of subpart D of this part. For an alternate flight safety system approved in accordance with § 417.107(a)(3), the launch operator must demonstrate the validity of the probability of failure through the licensing process.	This eliminates the need for guessing the time period or environment. **A** failure probability of 0.002 equates to a reliability of 0.998 which is close to what EWR-127 specified (0.999).
(iii) Current population density data and population projections for the day and time of flight for the areas outside the flight safety limits.	(iii) Current population density data and population projections for the day and time of flight for the areas outside the flight safcty limits as provided by the FAA or the **Air** Force Range safety organizations.	**The** population model should be maintained and provided by the FAA or the Air Force Range Safety organizations.
(c) Debris risk analysis products. The products of a debris risk analysis that a launch		

FAA SNPRM	Suggested Change or Comment	Rationale
operator must submit to the FAA as required by § 417.203(e) must include:		
(1) A debris risk analysis report that provides the analysis input data, probabilistic risk determination methods, sample computations, and text or graphical charts that characterize the public risk to geographical areas for each launch.		
(2) Geographic data showing:		
(i) The launch vehicle nominal, five-sigma left-crossrangc and five-sigma right-crossrange instantaneous impact point ground traces;	Note: The FAA did not respond to the Industry NPRM comments on this topic. The five-sigma limit should be replaced by the limit ref	
(ii) All exclusion zones relative to the instantaneous impact point ground traces; and		
(iii) All populatcd areas included in the debris risk analysis.		
(3) A discussion of each launch vehicle failure scenario accounted for in the analysis and the probability of occurrence, which may vary with flight time, for each failure scenario. This information must include failure scenarios where a launch vehicle:		
(i) Flies within normal limits until some malfunction causes spontaneous breakup or results in a commanded flight termination;		
(ii) Experiences malfunction turns; and		
(iii) Flight safety system fails to function.		
(4) A population model applicable to the launch overflight regions that contains the following: region identification, location of the center of each population center by geodetic latitude and longitude, total area, number of persons in each population center, and a description of the shelter characteristics within the population center.	The FAA or the Air Force Range Safety organizations should provide the demographic model used for the risk analysis. The risk analyst need only reference the model in the final report.	
(5) A description of the launch vehicle. including general information concerning the		

FAA SNPKM	Suggested Change or Comment	Rationale
nature and purpose of the launch and an overview of the launch vehicle, including a scaled diagram of the general arrangement and dimensions of the vehicle. **A** launch opcrator's debris risk analysis products may reference other documentation submitted to the FAA containing this information. The launch operator must identify any changes in the launch vehicle description from that submitted during the licensing process in accordance with § 415.109(c). The description must include:		
(i) Weights and dimensions of each stage.		
(ii) Weights and dimensions of any booster motors attached.		
(iii) The types of fuel used in each stage and booster.		
(iv) Weights and dimensions of all interstage adapters and skirts.		
(v) Payload dimensions, materials, construction, any payload fuel; payload fairing construction, materials. and dimensions; and any non-inert components or materials that add to the effective casualty area of the debris, such as radioactive or toxic materials or high-pressure **vessels.**		
(6) **A** typical sequence of events showing times of ignition, cutoff, burnout, and jettison of each stage, firing of any ullage rockets, and starting and ending times of coast periods and control modes.		
(7) The following information for each launch vehicle motor:		
(i) Propellant type and composition;		
(ii) Vacuum thrust profile;	(ii) ~~Vacuum~~ Thrust profile;	Thrust adjusted for altitude should be acceptabl as well as vacuum thrust.
(iii) Propellant weight and total motor weight as a function of time;		
(iv) A description of each nozzle and steering mechanism;		
(v) For solid rocket motors, internal pressure		

FAA SNPRM	Suggested Change or Comment	Rationale
and average propellant thickness, or borehole radius, as a function of time;		
(vi) Maximum impact point deviations as a function of failure time during destruct system delays. Bum rate as a function of ambient pressure;		
(vii) **A** discussion **of** whether a commanded destruct could ignite a non-thrusting motor, and if so, under what conditions; and		
(viii) Nozzle exit and entrance areas.		
(8) The launch vehicle's launch and failure history, including a summary of past vehicle performance. For a new vehicle with little or no flight history, a launch operator must provide data on similar vehicles that include:		
(i) Identification of the launches that have occurred;		
(ii) Launch date, location, and direction of each launch;		
(iii) The number of launches that performed normally;		
(iv) Behavior and impact location of each abnormal experience;	The impact location of each abnormal experience may not be known accurately, and therefore could not necessarily be provided.	
(v) The time, altitude, and nature of each malfunction; and		
(vi) Descriptions of corrective actions taken, including changes in vehicle design, flight termination, and guidance and control hardware and software.		
(9) The values of probability of impact (P_i) and expected casualty (E_c) for each populated area.		

FAA SNPRM	Suggested Change or Comment	Rationale
A417.27 Toxic release hazard analysis.		
A flight safety analysis must include a toxic release hazard analysis that satisfies the requirements of § 417.227. A launch operator's toxic release hazard analysis must satisfy the methodology requirements contained in appendix I of part 417. **A** launch operator must submit the analysis products identified in appendix I as required by § 417.203(e).	Prior to a Final Rule, the Industry requests a briefing from the Common Standards Workin; Group to fully understand the proposed toxic l limit and the affect this change would have, if any, on launch availability at the Ranges for current anc proposed vehicle configurations.	
A417.29 Far field blast overpressure effects.		
(a) General. A flight safety analysis must include a far field blast overpressure effects hazard analysis that satisfies the requirements of § 417.229. The requirements of this section apply to the computation of far field blast overpressure effects from the proposed flight of a launch vehicle as required by § 417.229 and to the analysis products that the launch operator must submit to the FAA as required by § 417.203(e). The analysis must account for distant focus overpressure and any overpressure enhancement to establish the potential for broken windows due to peak incident overpressures below 1.0 psi and related casualties due to falling or projected glass shards. The analysis must employ either paragraph (b) of this section or the risk analysis of paragraph (c) of this section.	Prior to a Final Rule, the Industry requests a briefing from the Common Standards Workin; Group to fully understand the proposed 1.0 ps ovcrprcssure requirement and the affect this changes would have, if any, on launch availability at the Ranges for current and proposed vehiclc configurations.	
(b) Far field blast overpressure hazard analysis. Unless an analysis satisfies the requirements of paragraph (c) of this section a far field blast overpressure hazard analysis must satisfy the following:		
(1) Explosive yield factors. The analysis must use explosive yield factor curves for each type or class of solid or liquid propellant used by the launch vehicle. Each explosive yield factor curve must be based on the most accurate		

FAA SNPRM	Suggested Change or Comment	Rationale
explosive yield data for the corresponding type or class of solid or liquid propellant based on empirical data or computational modeling.		
(2) Establish the maximum credible explosive yield. The analysis must establish the maximum credible explosive yield resulting from normal and malfunctioning launch vehicle flight. The explosive yield must account for impact mass and velocity of impact on the Earth's surface. The analysis must account for explosive yield expressed as a TNT equivalent for peak overpressure.		
(3) Characterize the population exposed to the hazard. The analysis must demonstrate whether any population centers are vulnerable to a distant focus overpressure hazard using the methodology provided by section 6.3.2.4 of the American National Standard Institute's **ANSI** S2.20-1983, "Estimating Air Blast Characteristics for Single Point Explosions in Air with a Guide to Evaluation of Atmospheric Propagation and Effects" and in accordance with the following:		
(i) For the purposes of this analysis, a population center must include any area outside the launch site and not under the launch operator's control that contains an exposed site. An exposed site includes any structure that may be occupied by human beings, and that has at least one window, but does not include automobiles, airplanes, and waterborne vessels. The analysis must account for the most recent census information on each population center. The analysis must treat any exposed site for which no census information is available, or the census information indicates a population equal to or less than four persons, as a 'single residence.'		
(ii) The analysis must identify the distance between the location of the maximum credible impact explosion and the location of each		

FAA SNPRM	Suggested Change or Comment	Rationale
population center potentially exposed. Unless the location of the potential explosion site is limited to a defined region, the analysis must account for the distance between the potential explosion site and a population center as the minimum distance between any point within the region contained by the flight safety limits and the nearest exposed site within the population center.		
(iii) The analysis must account for weather conditions optimized for a distant focus overpressure hazard and use an atmospheric blast "focus factor" (F) of 5.		
(iv) The analysis must determine, using the methodology of section 6.3.2.4 of **ANSI** S2.20-1983, for each a population center, whether the maximum credible explosive yield of a launch meets, cxcccds or is less than the "no damage yield limit," of the population center. If the maximum credible explosive yield is less than the "no damage yield limit" for all exposed sites, the remaining requirements of this section do not apply. If the maximum credible explosive yield meets or exceeds the "no damage yield limit" for a population center then that population center is vulnerable to far field blast overpressure from the launch and the requirements of paragraphs (b)(4) and (b)(5) of this section apply.		
(4) Estimate the quantity of broken windows. The analysis must use a focus factor of 5 and the methods provided by **ANSI** S2.20-1983 to estimate the number of potential broken windows within each population center determined to be vulnerable to the distant focus overpressure hazard in accordance with paragraph (b)(3) of this section.		
(5) Determine and implement measures necessary to prevent distant focus overpressure from breaking windows. For each population center that is vulnerable to far field blast overpressure irom a iauncn, rne anaiysis must		

FAA SNPRM	Suggested Change or Comment	Rationale
idcntify mitigation measures to protect the public from serious injury from broken windows and the flight commit criteria of § 417.113(b) needed to enforce the mitigation measures. **A** launch operator's mitigation measures must include one or more of the following:		
(i) Apply a minimum 4-millimeter thick anti-shatter film to all exposed sites where the maximum credible yield cxcccds the "no damage yield limit."		
(ii) Evacuate the exposed public to a location that is not vulnerable to the distant focus overpressure hazard at least two hours prior to the planned flieht time.		
(iii) If, in accordance with paragraph (b)(4) of this scction, the analysis predicts that less than 20 windows will break, advise the public of the potential for glass breakage.		
(c) Far field blast overpressure risk analysis. If a launch opcrator does not employ paragraph (b) of this section to perform a far field overpressure hazard analysis, the launch operator must conduct a risk analysis that demonstrates that the launch will be conducted in accordance with the public risk criteria of § 417.107(b).		
(d) Far field blast overpressure effect products. The products of a far field blast overpressure analysis that a launch operator must submit to the FAA as required by § 417.203(e) must include:		
(1) **A** description of the methodology used to produce the far field blast overpressure analysis results, a tabular description of the analysis input data, and a description of any far field blast ovemressure mitigation measures implemented.		
(2) For any far field blast overpressure risk analysis, an example set of the analysis computations.		
(3) The values for the maximum credible		

FAA SNPRM	Suggested Change or Comment	Rationale
explosive yield as a function of time of flight.		
(4) The distance between the potential explosion location and any population center vulnerable to the far field blast overpressure hazard. For each population center, the launch operator must identify the exposed populations by location and number of people.		
(5) Any mitigation measures established to protect the public from far field blast overpressure hazards and any flight commit criteria established to ensure the mitigation measures are enforced.		
A417.31 Collision avoidance.		
(a) General. A flight safety analysis must include a collision avoidance analysis that satisfies the requirements of § 417.231. The requirements of this section apply to the process of obtaining a collision avoidance assessment from United States Space Command as required by § 417.231 and to the analysis products that the launch operator must submit to the FAA as required by § 417.203(c). United States Space Command refers to a collision avoidance analysis for a space launch as a conjunction on launch assessment.		
(b) Analysis constraints. A launch operator must satisfy the following when obtaining and implementing the results of a collision avoidance analysis:		
(1) A launch operator must provide United States Space Command with the launch window and trajectory data needed to perform a conjunction on launch assessment for a launch as required by paragraph (c) of this section, at least 15 days before the first attempt at flight. The FAA will identify a launch operator to United States Space Command as part of issuing a license and provide a launch operator with current United States Space Command contact information.		
(2) A launch operator must obtain a		

FAA SNPKM	Suggested Change or Comment	Rationale
conjunction on launch assessment performed by United States Space Command 6 hours before the beginning of a launch window.		
(3) A launch operator may use a conjunction on launch assessment for 12 hours from the time that United States Space Command determines the state vectors of the habitable orbiting objects. If a launch operator needs an updated conjunction on launch assessment due to a launch delay, the launch operator must submit the request to United States Space Command at least 12 hours prior to the beginning of the new launch window.		
(4) For every 90 minutes, or portion of 90 minutes, that pass between the time United States Space Command last determined the state vectors of the orbiting objects, a launch operator must expand each wait in a launch window by subtracting 15 seconds from the start of the wait in the launch window and adding 15 seconds to the end of the wait in the launch window. A launch operator must incorporate all the resulting waits in the launch window into its flight commit criteria established as reauired bv 6 417.113.	For every 90 minutes, or portion of 90 minutes, that pass between the time United States Space Command last determined the state vectors of the habitable orbiting objects, a launch operator must expand each wait in a launch window by subtracting 15 seconds from the start of the wait in the launch window and adding 15 seconds to the end of the wait in the launch window. A launch operator must incorporate all the resulting waits in the launch window into its flight commit criteria established as reauired bv 6 417.113.	Note: The same comment by the Industry was not addressed by the FAA in the previous Industry comments to the NPRM. Padding the launch window wait is conservative, but acceptable for the habitable orbital objects. However, padding the launch window wait is not advisable for the other orbital objects, since the extra conservatism unnecessarily decreases, or possibly eliminates, the launch window.
(c) Information required. A launch operator must prepare a conjunction on launch assessment worksheet for each launch using a standardized format that contains the input data required by this paragraph. A launch operator must submit the input data to United States Space Command for the purposes of completing a conjunction on launch assessment. A launch operator must submit the input data to the FAA as part of the license application process in accordance with § 415.115.		
(1) Launch information. A launch operator must submit the following launch information:		
(i) Mission name. A mnemonic given to the launch vehicle/payload combination identifying the launch mission from all others.		
(ii) Segment number. A segment is defined		

FAA SNPRM	Suggested Change or Comment	Rationale
as a launch vehicle stage or payload after the thrusting portion of its flight has ended. This includes the jettison or deployment of any stage or payload. A launch operator must provide a separate worksheet for each segment. For each segment, a launch opcrator must determine the "vector at injection" as defined by paragraph (c)(5) of this section. The data must present each segment number as a sequence number relative to the total number of segments for a launch, such as "1 of 5."		
(iii) Launch window. The launch window opening and closing times in Greenwich Mean Time (referred to as ZULU time) and the Julian dates for each scheduled launch attempt.		
(2) Point of contact. The person or office within a launch operator's organization that collects, analyzes, and distributes conjunction on launch assessment results.		
(3) Conjunction on launch assessment analysis results transmission medium. A launch operator must identify the transmission medium, such as voice, FAX, or e-mail, for receiving results from United States Space Command.		
(4) Requestor launch operator needs. **A** launch operator must indicate the types of analysis output formats required for establishing flight commit criteria for a launch:		
(i) Waits. All the times within the launch window during which flight must not be initiated.		
(ii) Windows. **All** the times within an overall launch window during which flight may bc initiated.		
(5) Vector at injection. A launch operator must identify the vector at injection for each segment. "Vector at injection" identifies the position and velocity of all orbital or suborbital segments after the thrust for a segment has ended.		
(i) Epoch. The epoch time, in Greenwich		

FAA SNPRM	Suggested Change or Comment	Rationale
Mean Time (GMT), of the expected launch vehicle liftoff time.		
(ii) Position and velocity. The position coordinates in the EFG coordinate system measured in kilometers and the EFG components measured in kilometers per second, of each launch vehicle stage or payload after any burnout, jettison, or deployment.		
(6) Time of powered flight. The elapsed time in seconds, from liftoff to arrival at the launch vehicle vector at injection. The input data must include the time of powered flight for each stage or jettisoned component measured from liftoff.		
(7) Time span for launch window tile (LWF). A launch operator must provide the following information regarding its launch window:		
(i) Launch window. The launch window measured in minutes from the initial proposed liftoff time.		
(ii) Time ofpowered flight. The time provided in accordance with paragraph (c)(6) of this section measured in minutes rounded up to the nearest integer minute.		
(iii) Screen duration. The time duration, after all thrusting periods of flight have ended, that a conjunction on launch assessment must screen for potential conjunctions with habitable orbital objects. Screen duration is measured in minutes and must be greater than or equal to 100 minutes for an orbital launch.		
(iv) Extra pad. An additional period of time for conjunction on launch assessment screening to ensure the entire first orbit is screened for potential conjunctions with habitable orbital objects. This time must be 10 minutes unless otherwise specified by United States Space Command.		
(v) Total. The summation total of the time spans provided in accordance with paragraphs (c)(7)(i) through (c)(7)(iv) expressed in minutes.		

FAA SNPRM	Suggested Change or Comment	Rationale
(8) Screening. A launch operator must select spherical or ellipsoidal screening as defined in this paragraph for determining any conjunction. The default must be the spherical screening method using an avoidance radius of 200 kilometers for habitable orbiting objects. If the launch operator requests screening for any uninhabitable objects, the default must be the spherical screening method using a miss-distance of 25 kilometers.		
(i) Spherical screening. Spherical screening utilizes an impact exclusion sphere centered on each orbiting object's center-of-mass to determine any conjunction. A launch operator must specify the avoidance radius for habitable objects and for any uninhabitable objects if the launch operator elects to perform the analysis for uninhabitable objects.		
(ii) Ellipsoidal. Ellipsoidal screening utilizes an impact exclusion ellipsoid of revolution centered on the orbiting object's center-of-mass to determine any conjunction. A launch operator must provide input in the UVW coordinate system in kilometers. The launch operator must provide delta-U measured in the radial-track direction, delta –V measured in the in-track direction, and delta –W measured in the cross-track direction.		
(9) Orbiting objects to evaluate. A launch operator must identify the orbiting objects to be included in the analysis.		
(10) Deliverable schedule/need dates. A launch operator must identify the times before flight, referred to as "L- times,'' for which the launch operator requests a conjunction on launch assessment,		
(d) Collision avoidance assessment products. A launch operator must submit its conjunction on launch assessment products as required by § 417.203(e) and must include the input data		

FAA SNPRM	Suggested Change or Comment	Rationale
required by paragraph (c) of this section. A launch operator must incorporate the result of the conjunction on launch assessment into its flight commit criteria established in accordance with § 417.113.		
A417.33 Unguided suborbital rocket flown with a wind weighting safety system.		
For launch of an unguided suborbital rocket flown with a wind weighting safety system, the flight safety analysis must satisfy the requirements of § 417.233. The analysis for an unguided suborbital rocket flown with a wind weighting safety system must incorporate the methodologies for trajcctory analysis, flight hazard area analysis, and wind weighting analysis contained in appendix C of this part. The analysis must also include a debris risk analysis performed in accordance with A417.25 and appendix B of this part and a collision avoidance analysis performed in accordance with A417.31.	More repetition.	
28. In B417.1 as proposed to be revised at 65 FR 64050, revise "§ 417.227" to read "§ 417.225".		
29. In B417.3 as proposed to be revised at 65 FR 64050, revise "§ 417.227(b)(5)" to rcad "§ 417.225".		
30. In B417.5(b)(1) as proposed to be revised at 65 FR 64051, revise "§ 417.205" to read "§ 417.207 and A417.7".		
31. In B417.5(b)(2) as proposed to be revised at 65 FR 64051, revise "§ 417.227(b)(6)" to read "A417.25".		
32. In B417.5(b)(3) as proposed to be revised at 65 FR 64051, revise "§ 4 17.209" to read "§ 417.211 and A417.11".		
33. In B417.5(c) as proposed to be revised at 65 FR 64051, revise "§ 417.205(c)" to read "§ 417.207 and A417.7".		

FAA SNPRM	Suggested Change or Comment	Rationale
34. In B417.7(a) as proposed to be revised at 65 FR 64052, revise "§ 417.227(b)(11)" to read "§ 417.225 and A417.25".		
35. In B417.9(a) as proposed to be revised at 65 **FR** 64056, revise "§ 417.227" to read "A417.25".		
36. In C417.1 as proposed to be revised at 65 FR 64057, revise "§ 417.235" to read "§ 417.233".		
37. In C417.3(g) as proposed to be revised at 65 FR 64059, revise "§ 417.235(g)" to read "A417.203(e)".		
38. In C417.5(a) as proposed to be revised at 65 FR 64059, revise "§ 417.235(c)" to read "§ 417.233".		
39. In C417.5(j) as proposed to be revised at 65 FR 64062, revise "§ 417.235(c)" to read "§ 417.203(e)".		
40. In C417.7(d) as proposed to be revised at 65 FR 64063, revise "§ 417.235(g)" to read "§ 417.203(e)".		
41. In D417.13(b) as proposed to be revised at 65 FR 64067, revise "§ 417.223(b)(3)" to read "§ 417.221 and A417.21".		
42. In D417.19(a) as proposed to be revised at 65 FR 64068, revise "§ 417.221(c)" to read "§ 417.219 and A417.19".		
43. In I417.1 as proposed to be revised at 65 FR 64116, revise "§ 417.229" to read "§ 417.227".		
44. In I417.5(e) as proposed to be revised at 65 FR 64119, revise "§ 417.203(c)" to read "§ 417.203(e)".		

Figure A417.9-1, Example Tumble Turn Velocity Vector Turn Angle Graph.

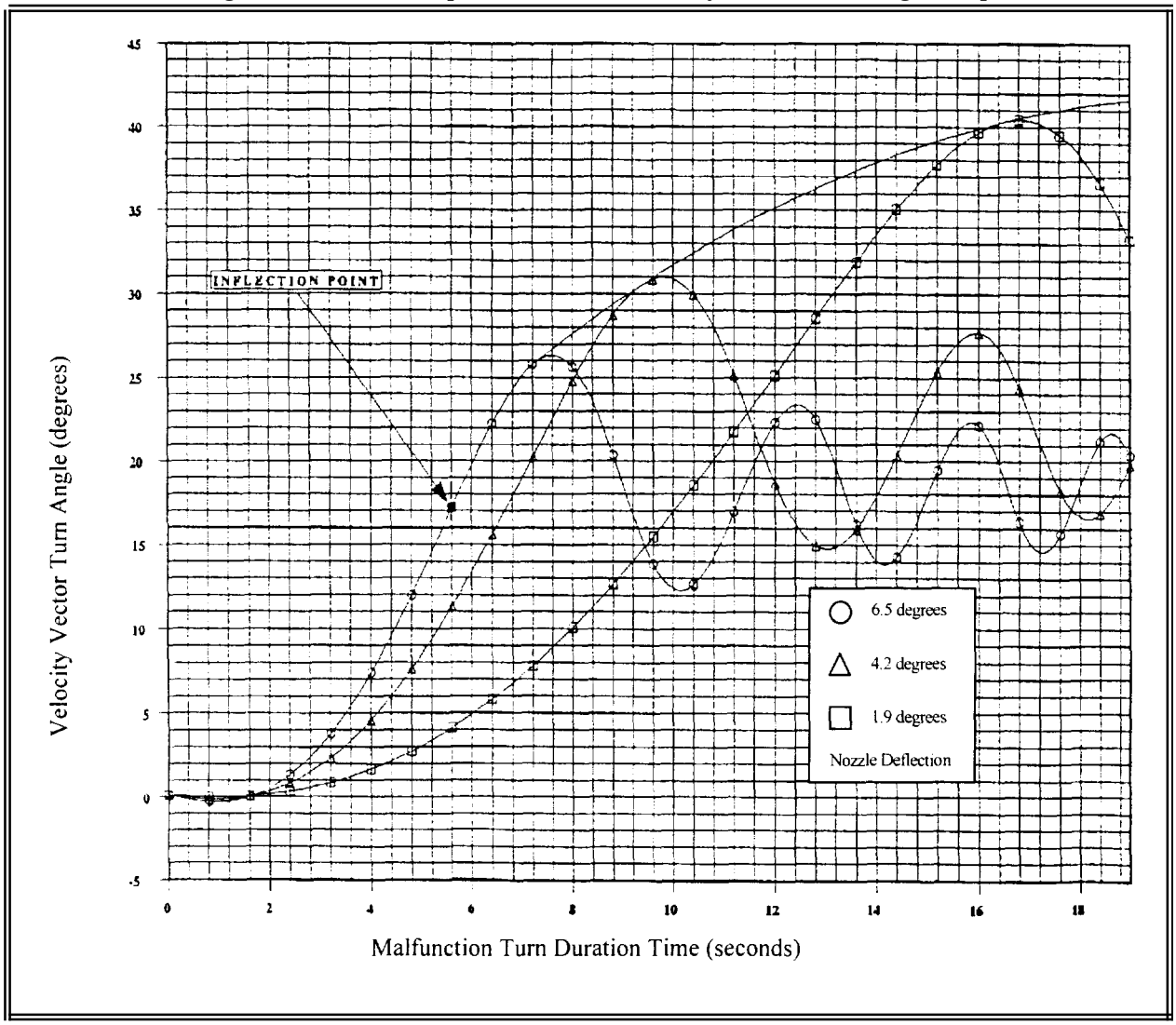
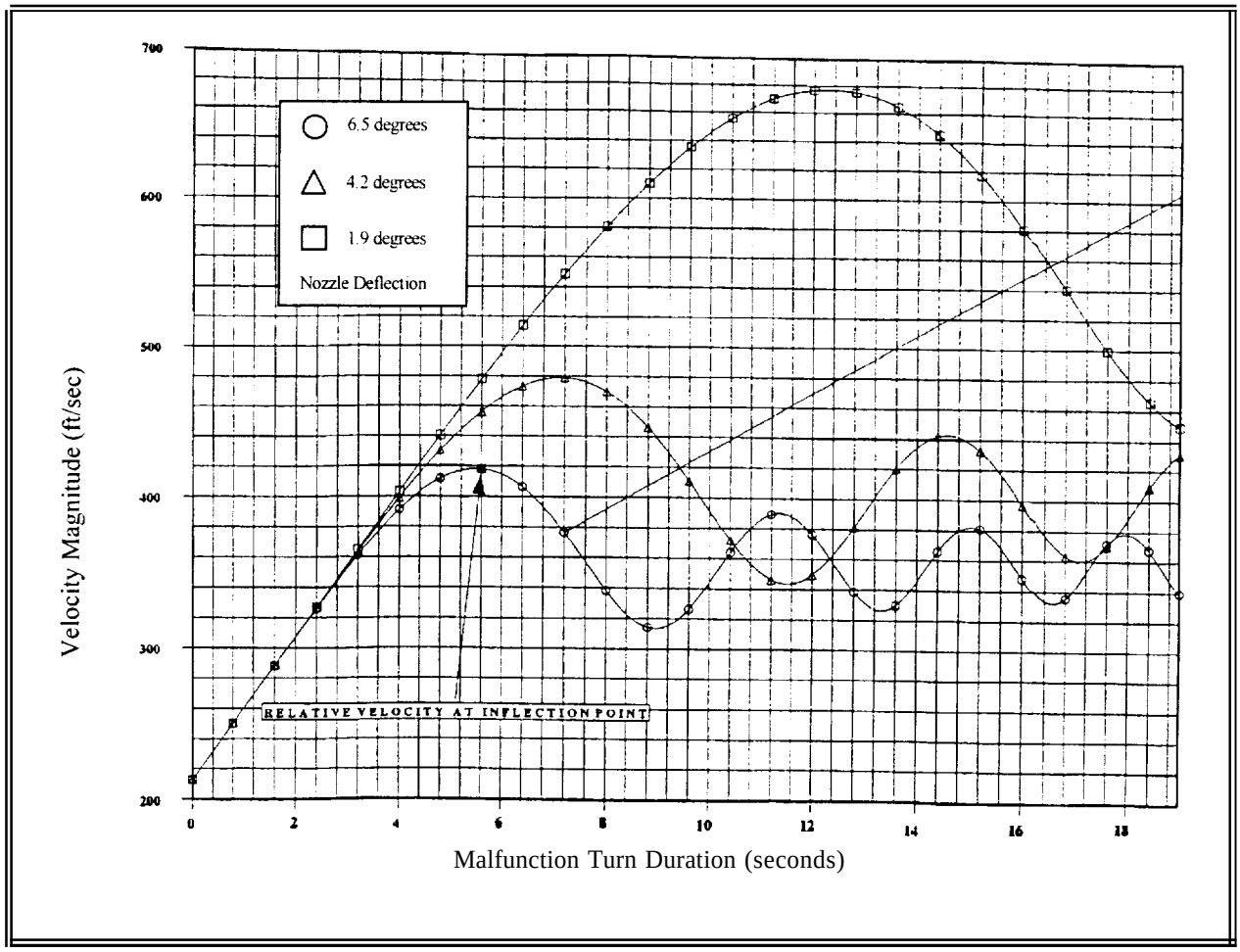


Figure A417.9-2, Illustrative Tumble Turn Velocity Magnitude Graph.



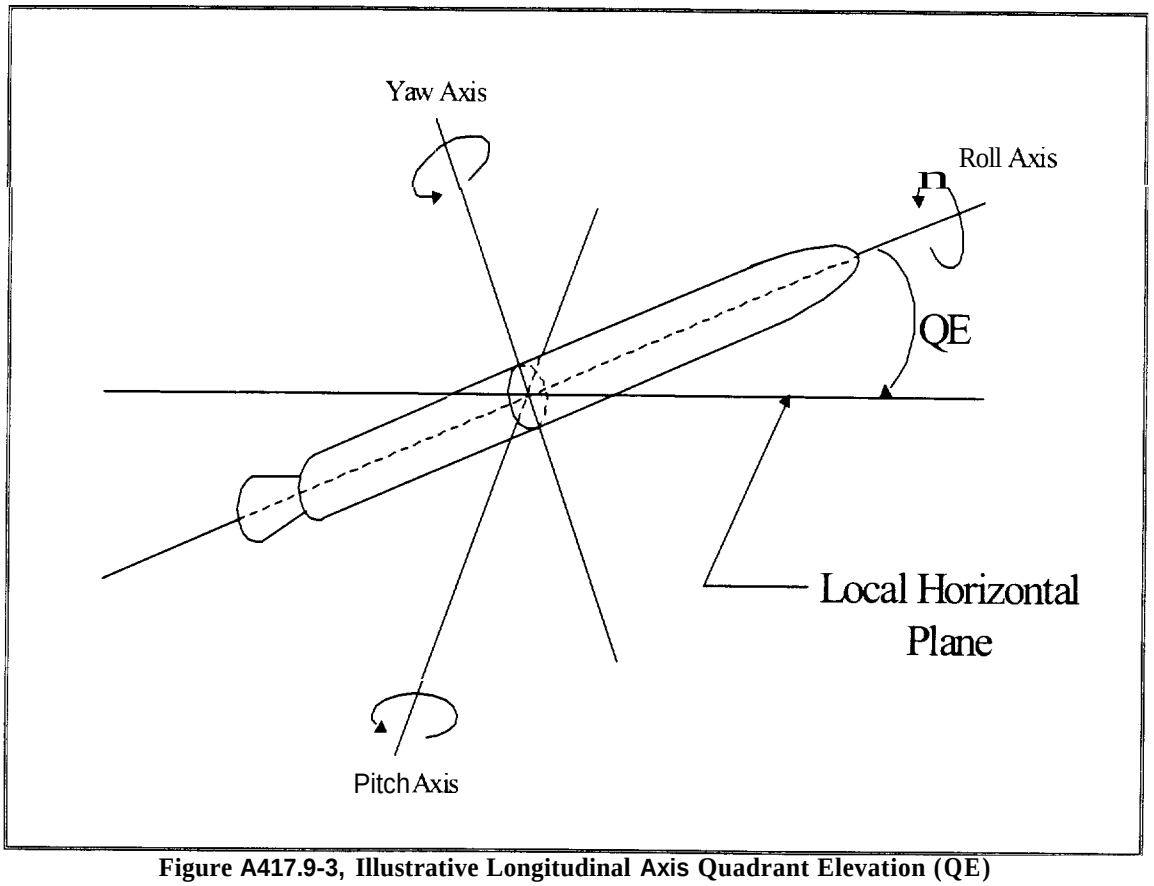
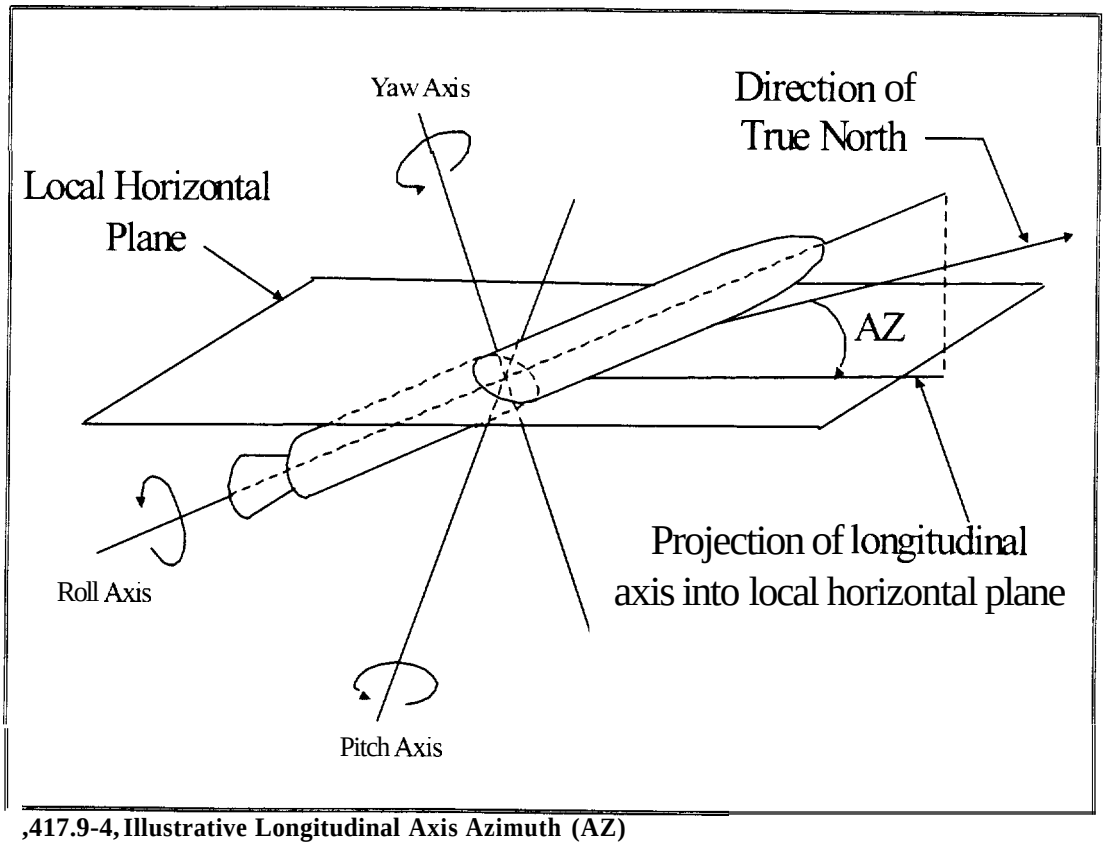


Figure A417.9-3, Illustrative Longitudinal Axis Quadrant Elevation (QE)



Figur ,417.9-4, Illustrative Longitudinal Axis Azimuth (AZ)

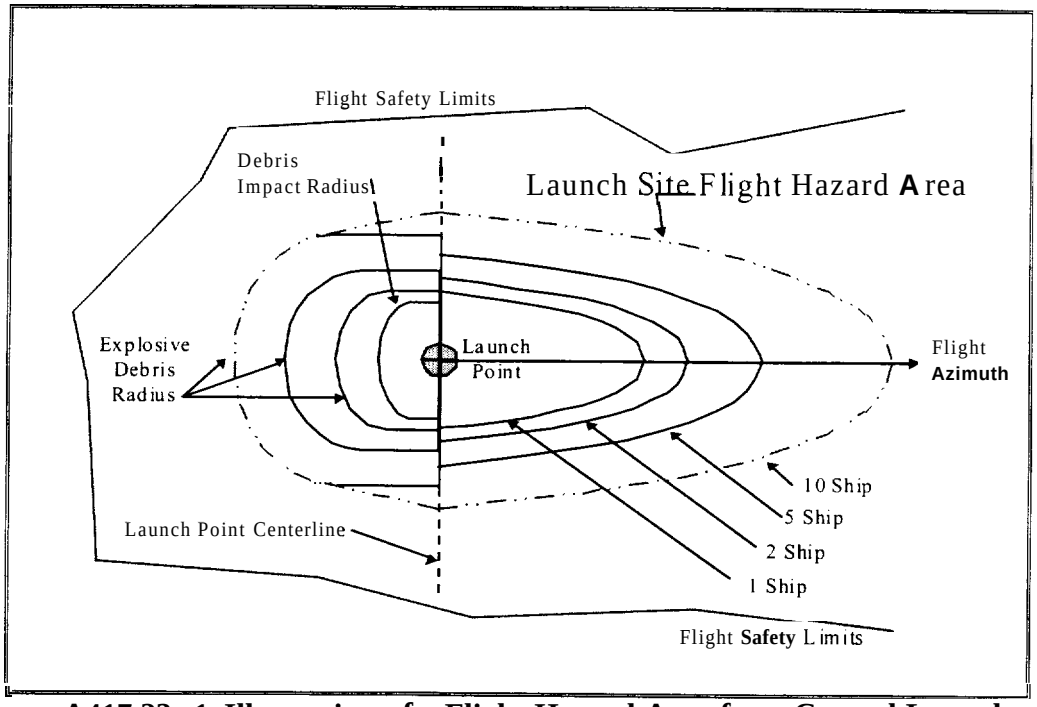


Figure A417.23- 1, Illustration of a Flight Hazard Area for a Coastal Launch ite

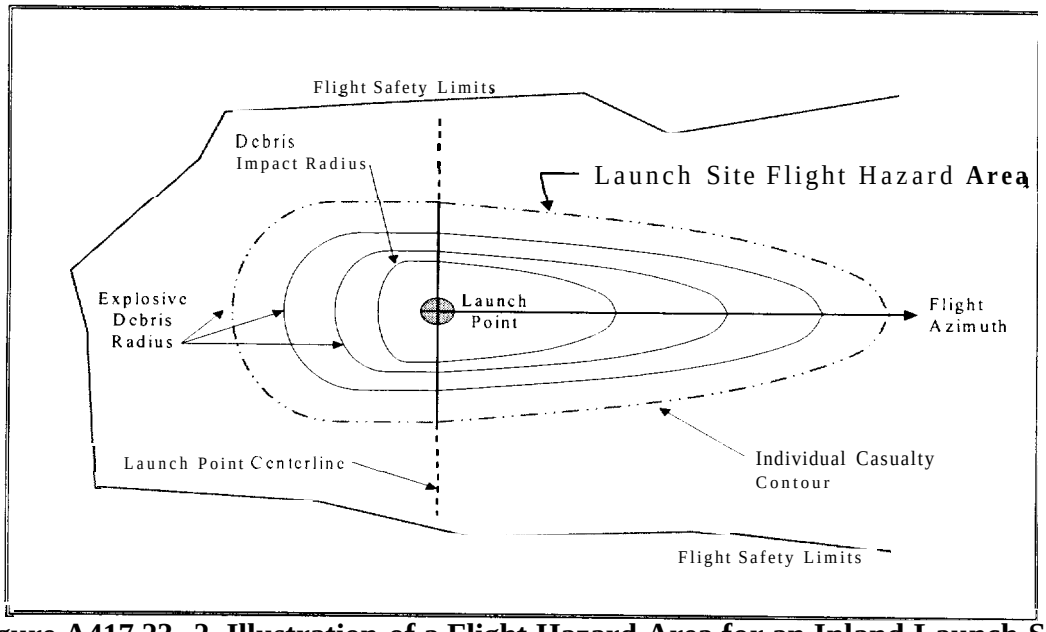


Figure A417.23- 2, Illustration of a Flight Hazard Area for an Inland Launch Site

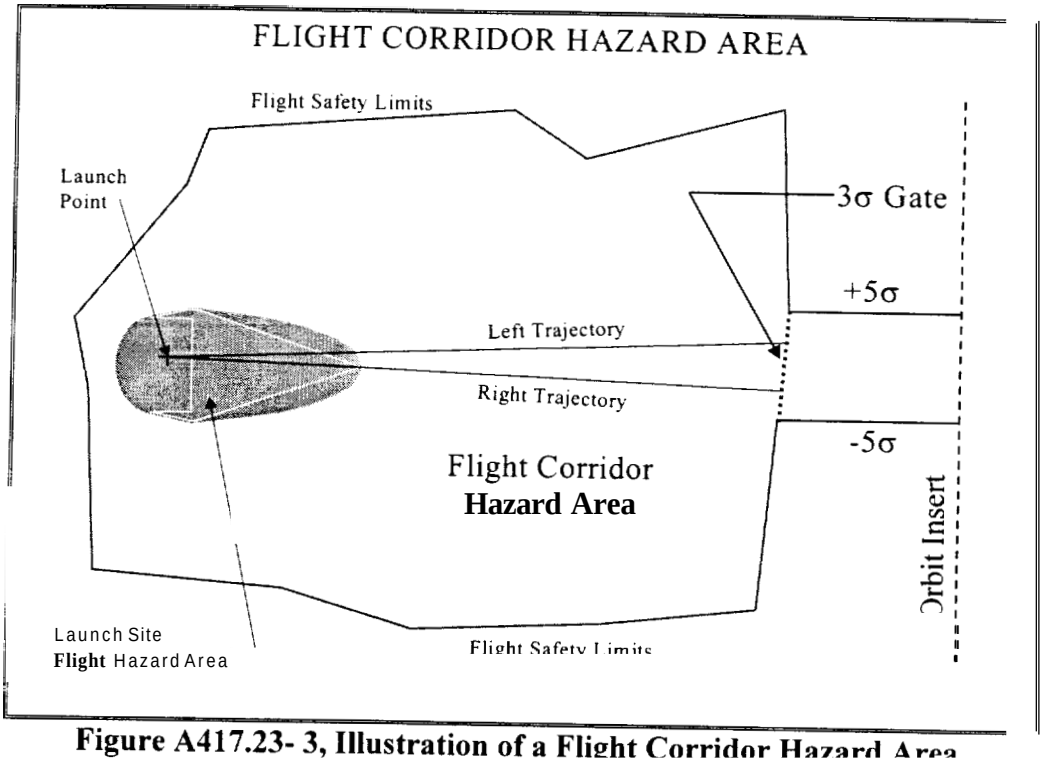


Figure A417.23- 3, Illustration of a Flight Corridor Hazard Area

Table A417-I, Liquid Propellant Explosive Equivalents

Proeellant Combinations	TNT Equivalents
LO_2/LH_2	The larger of $8W^{2/3}$ or 14% of W. Where W is the weight of LO2/LH2.
$LO_2/LH_2 + LO_2/RP\text{-}1$	Sum of (20% for $LO_2/RP\text{-}1$) the larger of $8W^{2/3}$ or 14% of W Where W is the weight of LO2/LH2.
$LO_2/RP\text{-}1$	20%' of W up to 500,000 pounds + 10% of W over 500.000 pounds. Where W is the weight of LO2/RP-1.
N_2O_4/N_2H_4 (or UDMH or UDMH/N_2H_4 Mixture)	10% of W Where W is the weight of the propellant.

Table A417-2, Propellant Hazard and Compatibility Groupings and

Factors to be Used When Converting Gallons of Propellant into Pounds

Propellant	Hazard Group	Compatibility Group	Pounds/gallon	°F	
Hydrogen Peroxide	II	**A**	11.6		68
Hydrazine	III	C	8.4		68
Liquid Hydrogen	III	C	0.59	-423	
Liquid Oxygen	II	**A**	9.5	-297	
Nitrogen Tetroxide	I	**A**	12.1		68
RP-1	I	C	6.8		68
UDMH	III	C	6.6	68	
UDHM/Hydrazine	III	C	7.5		68